Report No. 16 of the

SIOUX LOOKOUT DISTRICT

Forest Resources Inventory

—1953—

Division of Timber Management

Ontario Department of Lands and Forests

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PREFACE

● Within the past decade forestry in Ontario has been undergoing a transition from the old economy into a new, more stable one. The old economy was one of forest liquidation. History teaches us that as population increased, the necessity for cleared land grew. In the pioneering stage of development the abundance of trees made wood excessively cheap, and encouraged extravagance. Throughout most of the nation's history wood-dependent industries have drawn on virgin forests, a stockpile of raw material prepared and waiting for them. That economy is now coming to a close.

The administration of timber lands is passing into a new phase — the economy of tree growing — a phase in which dollar costs are incurred in timber production. Emergence into the new forest economy has been accompanied by unprecedented progress in the protection of forests from destructive agencies; the opportunity for utilizing inferior species and materials; an increase in wood prices through reduction of natural supplies on which no cost of production need be charged; the development of a desire for permanent investment instead of speculative ones; and an extension of government functions leading to the practice of forestry by the state on a large scale. When forestry is to be practised as an independent industry it becomes desirable, as in any large business undertaking, to plan, organize and manage the business so as to secure, continuously and systematically, a regular, nearly equal annual yield.

The forest exploiter also plans and organizes his business for annual returns, not, however, to be derived continuously from the same ground; he seeks a new field of exploitation, changing the location as soon as the accumulated stores of wood in the virgin forests have been exhausted. The forest property is then abandoned and devoted to purposes other than wood production, or if unsuitable for other than forest production, may remain barren over long periods.

The business of forestry is based upon the conception of what is technically called the "sustained yield," a continued systematic use of the same property for wood-crops, the best and largest possible. This is secured by proper attention to silviculture, replacement of the harvested crop, and protecting and tending it until ready for harvesting again. Finally, when the industry is fully established, this sustained yield is annually derived as far as practicable in equal or nearly equal amounts forever, under an "annual sustained yield management."

In order to secure the data upon which sustained yield management may be brought about, a forest survey is necessary. In 1946 Ontario set in motion plans for carrying out a forest resources inventory covering the exploitable forest area of the Province. Commencing April 1, 1951, the Federal Department of Resources and Development has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement with the Province pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Department of Lands and Forests has set up twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers sixteen complete and parts of two of these forest administrative districts, totalling 172,000 square miles, and comprising the accessible forest area of Ontario. This report, the sixteenth in the series, deals with the results of the inventory in the Sioux Lookout district.

While the report deals primarily with the physical resources, the underlying purpose has been to measure the capacity of the forest to contribute to employment and community welfare, and to the industrial and commercial development of the Province as a whole. This objective may be attained most effectively through the use of the comprehensive forest resources data in the preparation of long term timber management plans.

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FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Sioux Lookout district included in this report is 15,056,839 acres or 23,526 square miles. Productive forest lands cover 75 per cent of the total area, water 17 per cent, non-productive forest lands 8 per cent and non-forested lands less than one per cent. Of the total area, over 99 per cent is Crown land and less than one per cent patented land.

2. The age class distribution represents a natural state due to the limited utilization within the district. For the productive forest on Crown lands the age class distribution shows: 46 per cent mature, 39 per cent immature, 12 per cent young growth and 3 per cent reproducing forest.

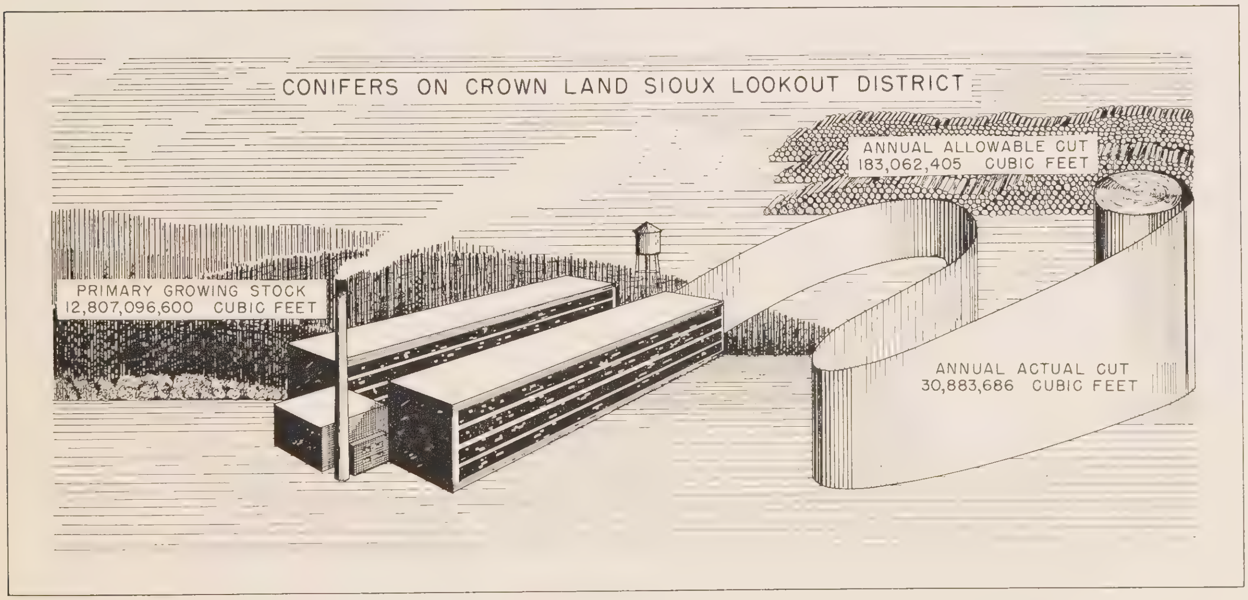
3. The cover type distribution for the productive forest and Crown forest areas is similar. The coniferous type occupies 68 per cent, the mixedwoods type 25 per cent and the hardwood type 3 per cent. Reproducing forest covers the remaining 4 per cent.

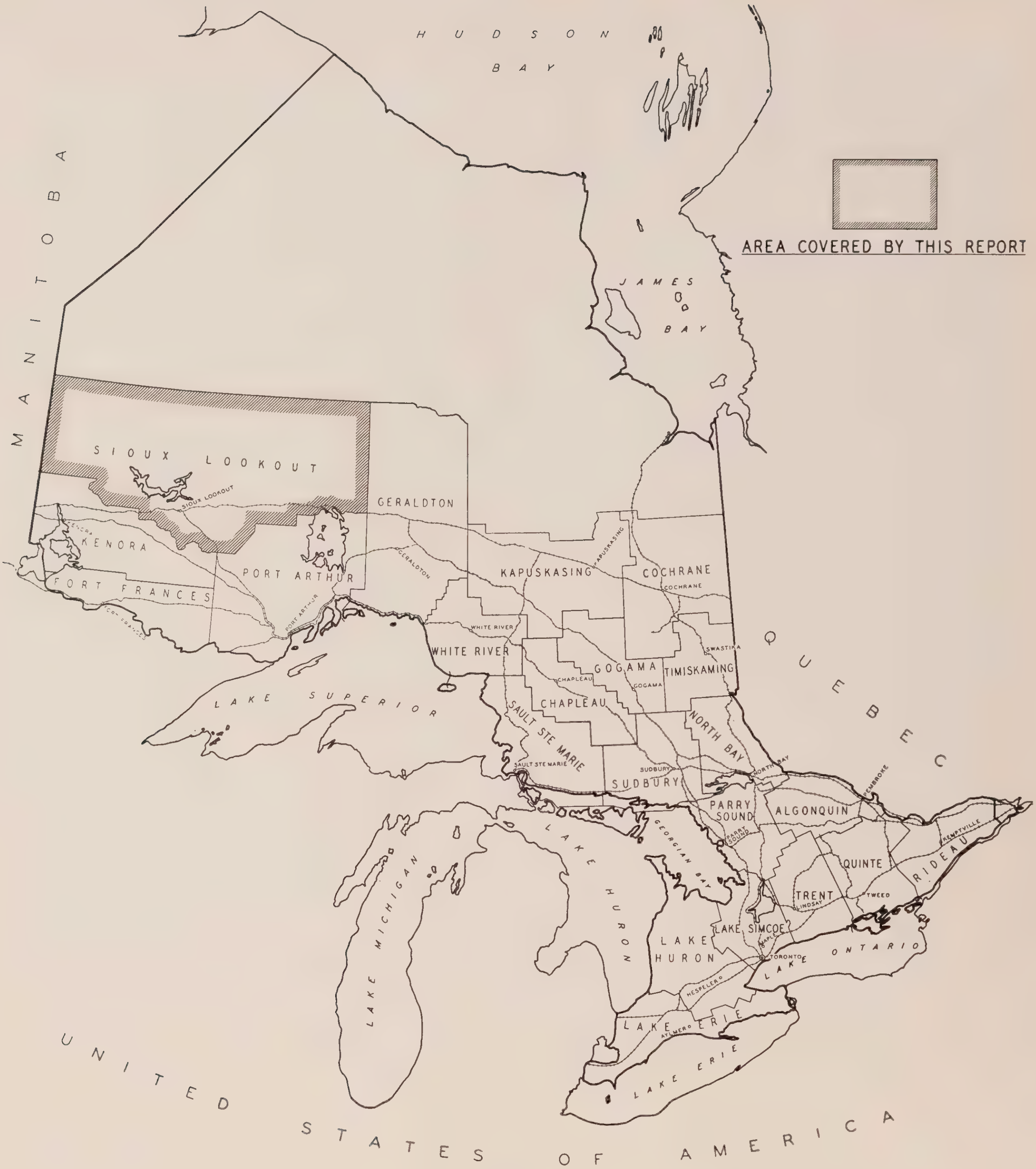
4. The volume of the primary growing stock on Crown lands in the Sioux Lookout district is 17,180,652,500 cubic feet or 1,539 cubic feet per acre. Conifers comprise 75 per cent of the total volume on Crown lands.

5. For the mature age class on Crown lands, 31 per cent of the coniferous volume and 60 per cent of the mature hardwood volume is in the sawlog size class, 10 inches d.b.h. and over. The main operable coniferous sawlog volumes are in jack pine and white spruce stands which contain 1,418 million cubic feet or 60 per cent of the mature coniferous sawlog volume. The sawlog content of black spruce stands is small in comparison to the pulpwood content and probably would not be recoverable as sawlogs in commercial operations.

6. The annual allowable cut for Crown lands in the Sioux Lookout district is 286,632,795 cubic feet. Conifers comprise 64 per cent of this volume, and hardwoods 36 per cent. The coniferous allowable cut is made up of 48 per cent jack pine, 43 per cent black and white spruce, and 9 per cent balsam fir. The hardwood allowable cut is 80 per cent poplar and 20 per cent white birch.

7. A comparison of the allowable cut with the actual utilization on Crown lands shows that only 17 per cent of the coniferous allowable cut was utilized, while less than one per cent of the hardwood allowable cut was taken. Of the wood utilized annually, white and black spruce comprised 68 per cent and jack pine 28 per cent. These species form 96 per cent of the actual cut; however, 27 per cent of the allowable cut for spruce and only 10 per cent of the allowable cut for jack pine was utilized.





MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES

Forest resources inventory photograph of Sioux Lookout, Ontario, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Background of the Report

● The Sioux Lookout district occupies a broad belt lying north of the Port Arthur and Kenora districts extending to north latitude 51 degrees. The trans-continental line of the Canadian National Railway traverses the district from east to west forming, in part, the southern boundary. Covering an area of 23,500 square miles, much of which is remote, undeveloped timber land, the district is about twice the size of the average district in the province.

The discovery of gold in the vicinity of Red Lake in 1925, with the inevitable inrush of prospectors, first attracted detailed attention to this remote section of north-western Ontario. Mining activity reached a peak in the summer of 1936, when the town of Red Lake became one of the busiest airports in the world. Unique for its time, this mining development was supplied mainly by air-lift for a period of twenty years, and was one of the first large mining enterprises to depend almost wholly on aircraft for transport.

To provide communication into the hinterland, primarily for the purpose of forest fire protection, the Department of Lands and Forests established radio service between Sioux Lookout and the town of Red Lake, which was extended to other camps active in the area. A local telephone service at Red Lake hooked up directly with radio-telephone service, which in turn connected with regular telephone lines at Sioux Lookout and Kenora. The radio link made it possible to talk directly over long distance telephone to any telephone on the local lines in the mining communities. The problems of transport and communication in the areas north of Sioux Lookout contributed a major part in proving the value of aircraft and radio in forestry and other work in inaccessible areas.

The topography and physiography of the Sioux Lookout district are typical of the Pre-Cambrian Shield in northern Ontario. The old eroded surface has been changed only in minor degree by the effects of Pleistocene glaciation. Glacial action has scoured and scraped off almost all weathered and decomposed rock from the higher ground, producing smooth and rounded rock surfaces, and has modified the valleys and drainage pattern by the deposition of glacial drift and morainal material.

Glacial lakes, the extent and position of which were controlled by the position of the receding ice front, have given rise to deposits of sand and clay which cover considerable areas in certain sections of the country. Extensive areas of sandy clay and clay soils lying in a broad belt extending from Lac Seul north to Trout Lake carry excellent stands of timber. Agricultural development is not warranted in the district at the present time; but should population increases and local markets make it feasible, suitable lands could be found.

Except for the gold mining industry which has declined in recent years, industrial development of the district is confined to a number of units of the sawmilling industry in the vicinity of Sioux Lookout and Hudson, the two main towns of the southern part of the district. Small sawmilling units have also developed in connection with the mining communities to the north. It is probable that in time the pulp and paper industry will become established on the basis of the substantial spruce resources of the district.

Areas

The total area of the Sioux Lookout district included in this report is 15,056,839 acres, 23,526 square miles. This area excludes Indian Reserve lands. For the purposes of this report the northerly boundary of the Sioux Lookout district may be described as — beginning at the Manitoba-Ontario boundary at 51° 7′ 30″ N. latitude and following a line due east to 91° W. longitude, thence 51° N. latitude due east to 88° W. longitude, thence 50° 37′ 30″ N. latitude due east to the Geraldton district boundary (fig. 1).

The Sioux Lookout district is essentially a timber producing area, with 11,228,291 acres or 75 per cent of the district area classified as productive forest land (table 1). Water occupies 2,527,427 acres or 17 per cent of the total area. Non-productive forest lands, which include lands permanently out of the commercial timber producing class due to very low productivity, cover 1,236,304 acres or 8 per cent of the total area. Non-forested lands cover only 64,817 acres or less than one per cent of the total area (fig. 2).

With only 290 acres classified as developed agricultural lands and 1,709 acres as grass and meadow land, farming in the district is almost non-existent.

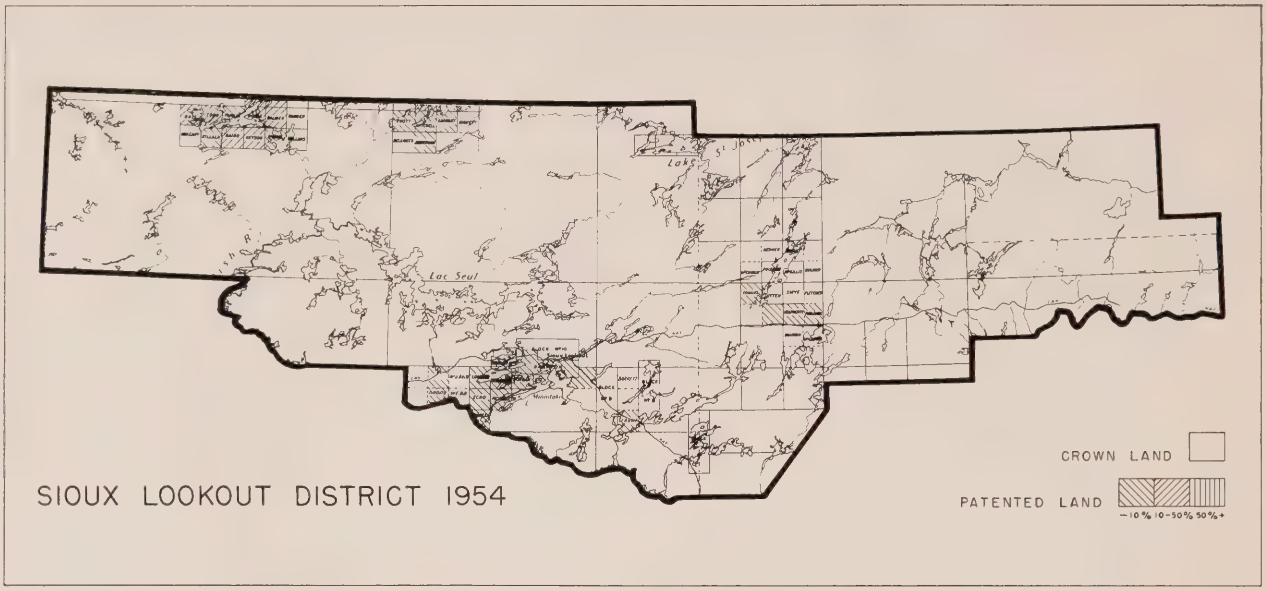


FIGURE 1

Although extensive agricultural development may not be feasible at these northern latitudes, soils suitable for farming do exist and appear to be fairly abundant in some sections.

An active outbreak of the spruce budworm (*Choristoneura fumiferana* (*Clem.*)) is centered between Lac Seul and Trout Lake. Balsam fir and white spruce have been subject to successive years of defoliation by the larvae of the insect; and mortality of the host trees, presently quite high, is continuing.

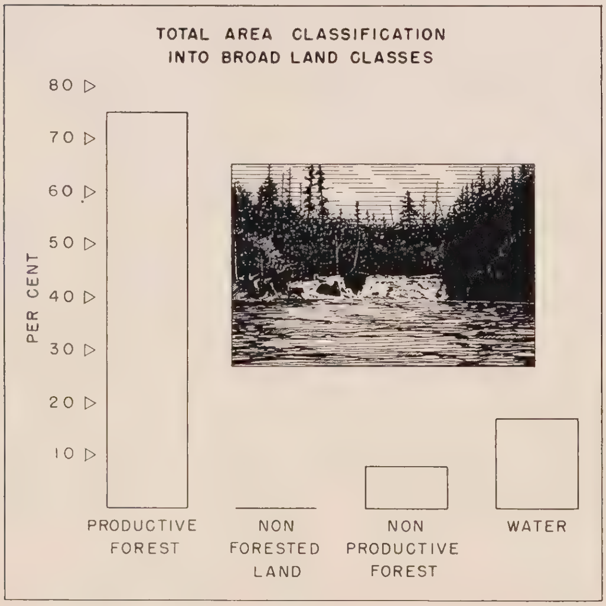


FIGURE 2

TABLE 1. — *Total area classification into broad land and ownership groupings.*

Kind of area	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	11,162,763	65,528	11,228,291
Non-forested land[2]			
Developed agricultural land	12	278	290
Grass and meadow land	1,539	170	1,709
Non-reproducing burn	10,104	....	10,104
Unclassified land[3]	48,285	4,429	52,714
TOTAL	59,940	4,877	64,817
Non-productive forest[4]			
Open muskeg	234,598	832	235,430
Treed muskeg (scrub)	739,673	1,604	741,277
Brush, alder, and flooded land	222,877	294	223,171
Rock outcrop	21,408	14	21,422
Barrens	15,004	....	15,004
TOTAL	1,233,560	2,744	1,236,304
Water	2,527,427	....	2,527,427
TOTAL AREA	14,983,690	73,149	15,056,839

1 Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

2 Productive forest lands permanently withdrawn from timber production use.

Lands occupied by roads, railroads, towns, etc.

4 Lands which appear to be permanently out of commercial timber producing class, owing to very low productivity.

Forest Land Ownership

It has been the policy in Ontario from the very beginning to retain forest land in public ownership, leasing to operators for varying lengths of time the right to cut and remove timber from the public domain. Lands suitable for agriculture have been opened for settlement and lands have been granted and sold under the various land settlement regulations which have been in force from time to time. Lands are also patented for mining purposes, summer resort, and for other uses. All of these various types of ownership are grouped under "patented lands" which include all lands owned privately in contrast to Crown lands. It has been the usual practice in Ontario, except on lands patented for agricultural purposes, to reserve all pine timber to the Crown at the time letters patent are issued, while on some lands patented for mining, all timber is reserved to the Crown. The ownership of timber on privately owned lands presents, therefore, a complicated picture. In the course of the inventory no attempt was made to record separately, timber occurring on patented land but reserved to and owned by the Crown.

In the Sioux Lookout district, land ownership is further complicated by four Grand Trunk Pacific blocks covering 268,435 acres. This area is actually patented land, but for purposes of this report is included in the Crown land area of the district. The area is managed as a forest property; and for the purposes of all volume calculations and the assessment of the allowable cut, these lands are treated as Crown lands in this report.

Of the total area of the Sioux Lookout district of 15,056,839 acres, 14,983,690 acres are in Crown ownership and 73,149 acres are patented land (table 1). Considering the total area of the district, over 99 per cent is Crown land and less than one per cent is patented land. If only the productive forest land totalling 11,228,291 acres is considered, 11,162,763 acres or 99 per cent is Crown land and 65,528 acres or one per cent is patented land. Patented land is further classified on a township basis into townships containing less than 10 per cent patented land; those containing between 10 and 50 per cent patented land and townships over 50 per cent patented land (fig. 1).

Age Classes

The Sioux Lookout district, with its sparse settlement, inadequate transportation facilities and its location far from the major markets, has an age class distribution representing a natural state, unmodified by exploitation or management practices. The requirements for sustained timber yields — a forest with trees of all age classes and stages of development from seedlings to mature timber, in

TABLE 2. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	per cent
Mature forest:				
Coniferous	3,668,235	20,538	3,688,773	33
Hardwood	118,259	500	118,759	1
Mixedwoods	1,304,117	17,348	1,321,465	12
TOTAL	5,090,611	38,386	5,128,997	46
Immature forest:				
Coniferous	3,085,731	4,826	3,090,557	27
Hardwood	200,827	1,466	202,293	2
Mixedwoods	1,067,478	6,116	1,073,594	10
TOTAL	4,354,036	12,408	4,366,444	39
Young growth:				
Coniferous	855,460	7,044	862,504	8
Hardwood	63,941	3,108	67,049	1
Mixedwoods	393,080	2,854	395,934	3
TOTAL	1,312,481	13,006	1,325,487	12
Reproducing forest	405,635	1,728	407,363	3
TOTAL PRODUCTIVE FOREST	11,162,763	65,528	11,228,291	100

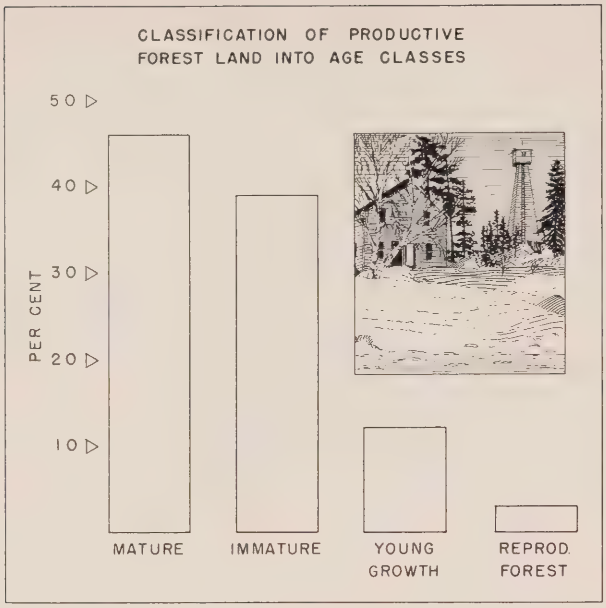


FIGURE 3

such proportions that when one group of trees is harvested, another is ready to take its place — are not met by the present preponderance of mature and immature age classes in the district.

In the Sioux Lookout district 5,128,997 acres or 46 per cent of the productive forest is mature (table 2). This accumulation of mature timber may be treated as a reserve which can be utilized throughout the rotation to permit a gradual normalization of age classes to be brought about, thus creating a sound foundation for a balanced sustained yield in the future. A somewhat smaller area of 4,366,444 acres or 39 per cent is in the immature age class. This area, which will mature progressively during the next 60 years, will supply industry after the mature timber has been cut and removed. Young growth and reproducing forest comprise 1,732,850 acres or 15 per cent of the productive forest (fig. 3). This area will supply the cut for 30 to 40 years after the mature and immature timber has been removed. Unless some of the presently immature stands are reserved to support the cut during this period, a marked decline in the allowable cut would take place. Since 99 per cent of the productive forest land in the district is Crown land, the age class distribution for the Crown land portion does not differ from the distribution for productive forest lands.

On patented lands the mature forest covers 38,386 acres or 59 per cent of the productive forest on patented lands. Immature forest covers 12,408 acres or 19 per cent, and the remaining 22 per cent is made up of 13,006 acres of young growth and 1,728 acres of reproducing forest.

Regional Forest Types

The forested area of the province has been divided into regions or ecological sections based on a broad uniformity of tree species associations resulting from climatic changes from south to north and from east to west. The response of the forest growth to overall climatic conditions is modified by the proximity of large bodies of water, topography, the distribution of broad soil types and other local conditions.

Separate volume and yield tables are prepared for each region or section and they serve as units in the compilation of volume estimates. In the Sioux Lookout district four forest regions or sections are represented (fig. 4) as follows:

1. The Central Plateau section in the east part of the district covers 29 per cent of the total area.
2. The Western Transition section in the south-central part of the district embraces 37 per cent of the total area.
3. The English River section in the south-west occupies 11 per cent of the total area.
4. The Northern Coniferous section in the north-west and north-central part of the district comprises 23 per cent of the total area.

The Central Plateau section covering 29 per cent of the area of the Sioux Lookout district is an important timber producing section. Jack pine stands, dense and of fine development, are a feature of this section. This is partly the result of fire, but also there is the possibility that factors allowing for natural regeneration are present. Spruce-fir stands, consisting of white spruce, black spruce, balsam fir, poplar and white birch occupy all of the well-drained heavier soils as a mature forest. Poplar and white birch are prominent in the immature stands.

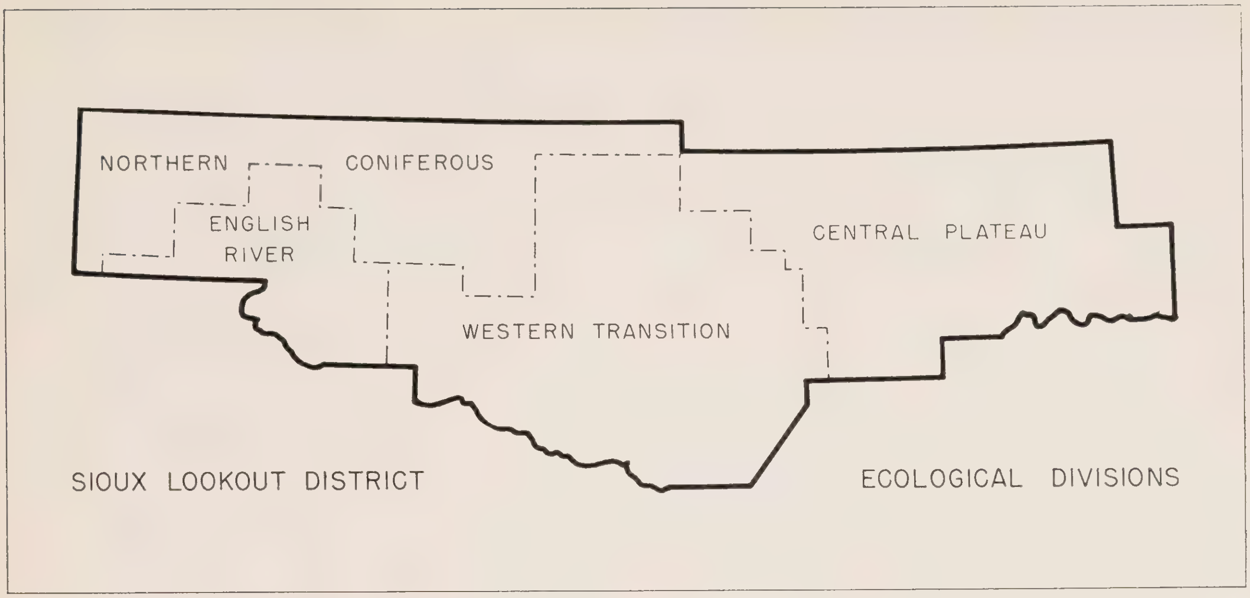


FIGURE 4

The Western Transition section lying in the south-central part of the district belongs to the Boreal Forest zone. It is marked by a rough, rolling topography with thin soils and numerous lakes. Strong glaciation exposed much of the rock, and repeated fires have increased the extent of the bared rock. The principal species are jack pine and black spruce. Mixtures of black and white spruce, balsam fir, white birch and poplar are common. The wide distribution of red and white pine as scattered individuals or isolated stands is characteristic of this region.

The English River section in the south-west part of the district where it joins the Province of Manitoba covers 11 per cent of the total area. This section was influenced by glacial Lake Agassiz and the generally thin soils of the region are intermixed with heavier soils. The area is relatively low and undulating. Jack pine is the most abundant species and with black and white spruce and balsam fir forms most of the forests. White and red pine have a limited occurrence on islands and on the rocky shorelines of the numerous lakes.

The Northern Coniferous section in the north part of the district covers 23 per cent of the total area. Climatic conditions are favourable for tree growth, but the thin soil cover and inadequate drainage conditions have resulted in a predominance of slow growing black spruce. Extensive fires have favoured the spread of jack pine which occupies the drier sites. White spruce, balsam fir and poplar occur where soil conditions are more favourable. White birch occurs as scattered individuals throughout most of the stands.

Cover Types

The forests of the Sioux Lookout district are made up of 10 common tree species. Six of these comprise 99 per cent of the total wood volume: black spruce 38 per cent, jack pine 27 per cent, poplar 18 per cent, white birch 7 per cent, balsam fir 6 per cent, and white spruce 3 per cent. White and red pine, white cedar and larch, are represented in the forests.

The forests of the district are described under three main cover types, coniferous, hardwood and mixedwoods. The coniferous type contains 75 per cent or more conifers or softwood trees; the hardwood type is composed of 75 per cent or more hardwood or broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there occur on all large forest tracts, areas of reproducing forests too recently established to have attained a sufficiently stable

Table 3. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	3,668,235	33	20,538	31	3,688,773	33
Immature	3,085,731	27	4,826	7	3,090,557	27
Young growth	855,460	8	7,044	11	862,504	8
Total	7,609,426	68	32,408	49	7,641,834	68
Hardwood type:						
Mature	118,259	1	500	1	118,759	1
Immature	200,827	2	1,466	2	202,293	2
Young growth	63,941	*	3,108	5	67,049	*
Total	383,027	3	5,074	8	388,101	3
Mixedwoods type:						
Mature	1,304,117	12	17,348	27	1,321,465	12
Immature	1,067,478	10	6,116	9	1,073,594	10
Young growth	393,080	3	2,854	4	395,934	3
Total	2,764,675	25	26,318	40	2,790,993	25
Reproducing forest	405,635	4	1,728	3	407,363	4
TOTAL PRODUCTIVE FOREST	11,162,763	100	65,528	100	11,228,291	100

* Less than one per cent.

composition to be classified into cover types. These areas are referred to as reproducing forest.

Cover type distribution over the productive forest

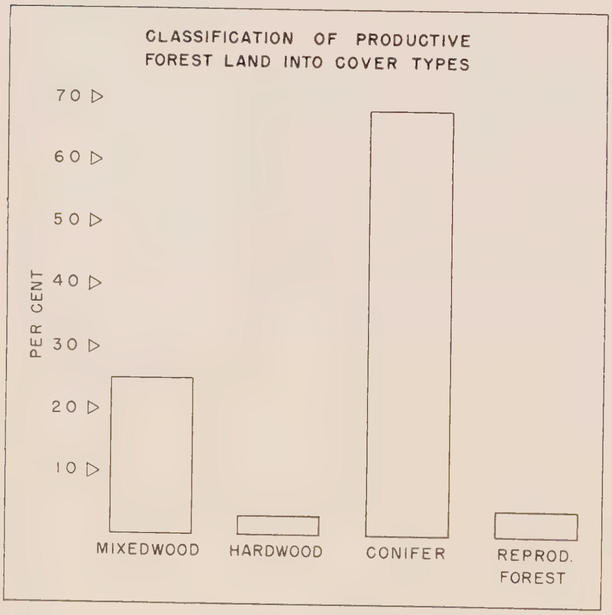


Figure 5

and Crown forest areas is similar, with the coniferous type occupying 68 per cent of the area (table 3), the mixedwoods type 25 per cent, and the hardwood type only 3 per cent. The remaining 4 per cent is reproducing forest (fig. 5).

Patented lands, occupying only one per cent of the productive forest land in the district, show a different cover type distribution. The coniferous type occupies 49 per cent of the area, the mixedwoods type 40 per cent, the hardwood type 8 per cent, and reproducing forest 3 per cent.

Volume

The volume of the primary growing stock includes all living trees, 3,6 inches d.b.h. outside bark and over, standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

The volume of the primary growing stock on productive forest lands in the Sioux Lookout district is just over 17 billion cubic feet (17,293,808,500 cubic feet). This is an average of 1,540 cubic feet per acre (table 4). The mature age class contains 10.6 billion cubic feet (table 5) or 2,057 cubic feet per acre, while the immature age class contains 6.7 billion cubic feet or 1,544 cubic feet per acre.

Table 4. — *Volume per acre of the primary growing stock.*

Cover type	Crown land			Patented land			Average Total
	4″–9″ d.b.h.	10″ up d.b.h.	Average	4″–9″ d.b.h.	10″ up d.b.h.	Average	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	1,264	790	2,054	1,355	1,068	2,423	2,057
Immature	1,336	209	1,545	1,357	267	1,624	1,544
Productive forest	1,097	442	1,539	1,051	676	1,727	1,540

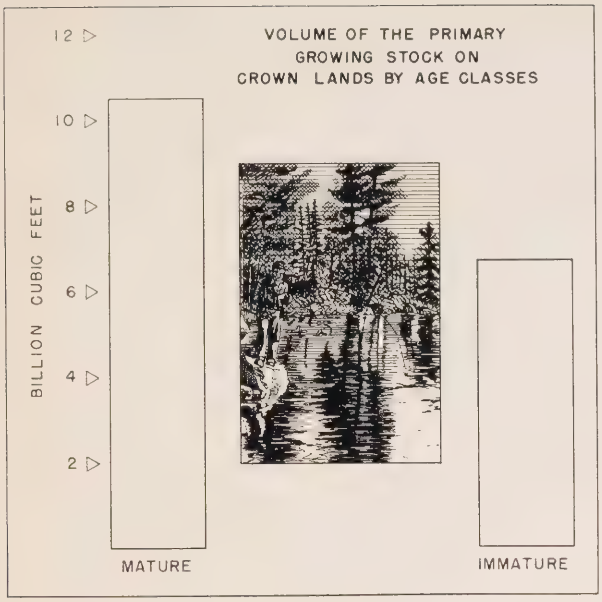


Figure 6

The volume of the primary growing stock on Crown lands in the Sioux Lookout district is 17,181 million cubic feet (table 6), or an average of 1,539 cubic feet per acre. The mature age class contains 10,457 million cubic feet or 2,054 cubic feet per acre; the immature age class has 6,723 million cubic feet or 1,545 cubic feet per acre (fig. 6).

Patented lands in the Sioux Lookout district have a total of 113 million cubic feet (table 7) or 1,727 cubic feet per acre. The mature age class contains 93 million cubic feet or 2,423 cubic feet per acre; and the immature age class contains 20 million cubic feet or 1,624 cubic feet per acre.

Conifers vs. Hardwoods

The commercially valuable conifers or softwood species make up 74 per cent of the primary growing stock in the Sioux Lookout district. The balance of 26 per cent is hardwood or broadleaved species, almost wholly poplar and white birch. Of the total volume of the primary growing stock on productive forest lands in the district amounting to 17.3 billion cubic feet, 12.9 billion cubic feet are conifers and 4.4 billion cubic feet are hardwoods (table 8). The mature age class contains 10,550 million cubic feet, which is made up of 74 per cent conifers and 26 per cent hardwoods. The immature age class, which is 75 per cent conifers and 25 per cent hardwoods, contains 6,744 million cubic feet.

On Crown lands, 12.8 billion cubic feet or 75 per cent is coniferous volume and 4.4 billion cubic feet or 25 per cent is hardwood volume (table 9). Both the mature and the immature age classes show the same percentage distribution for conifers and hardwoods as for the productive forest area.

On patented lands the volume of conifers is about 74 million cubic feet or 65 per cent of the total volume, while the volume of hardwoods is 39 million cubic feet or 35 per cent of the total volume (table 10).

The most important conifer is black spruce, which makes up 51 per cent of the total cubic volume of conifers on Crown lands (fig. 7). It is followed by jack pine with 36 per cent, balsam fir 8 per cent and white spruce 4 per cent. The remaining one per cent is made up of white cedar, larch and red and white pine.

A survey camp on the shore of a frozen lake in the far north is serviced by Department aircraft.

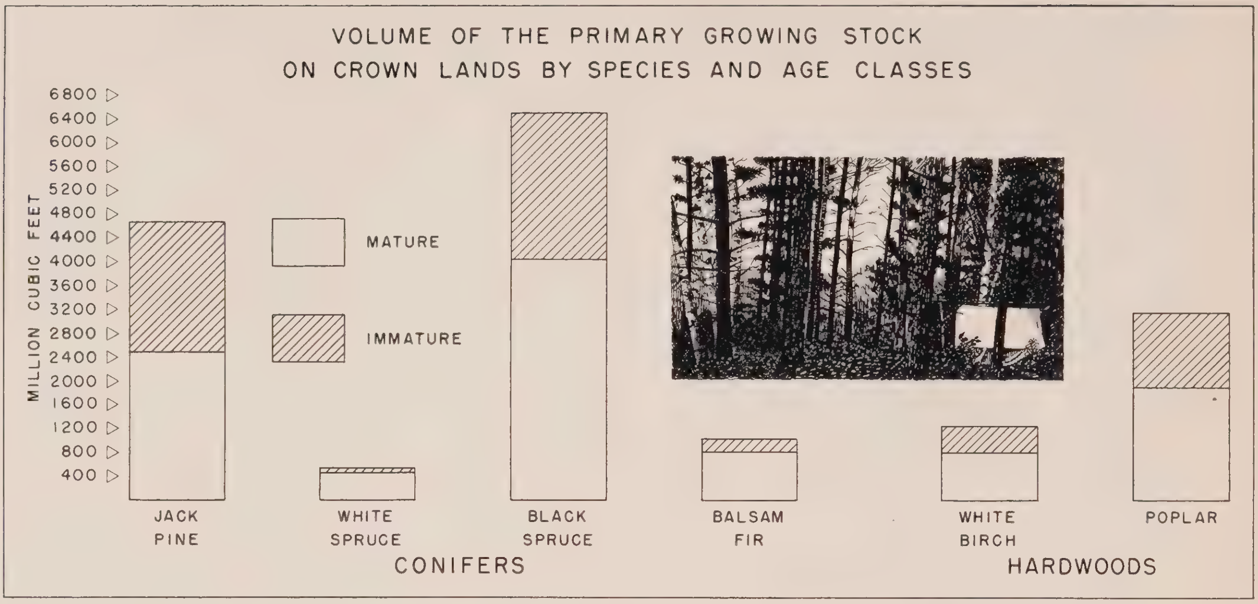


FIGURE 7

Only two hardwoods, poplar and white birch, occur in appreciable amounts. Poplar is the most abundant hardwood, comprising 72 per cent of the hardwood volume on Crown lands. White birch accounts for the remaining 28 per cent, while other hardwood species have an inappreciable volume.

Sawlogs vs. Pulpwood

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4–9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. The smaller size class material is regarded as principally of value for pulpwood or cordwood, depending on species, although some of this size class material may be diverted to use as poles, posts, railway ties and mining timbers. Volumes in the 10 inch and over size class have values for sawlogs and other uses where larger timber is required. A tree 10 inches d.b.h. outside bark will on the average produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller size material in the top which may be used as pulpwood or for purposes other than sawlogs. The total quantity of wood in the residual top is relatively small and is included in the 10 inch and over material in all inventory estimates.

Crown lands contain over 99 per cent of the total wood volume in the Sioux Lookout district. Considering both mature and immature age classes the 4–9 inch size class contains 12,250 million cubic feet or 71 per cent of the volume and the 10 inch and over class contains 4,931 million cubic feet or 29 per cent of the volume on Crown lands (table 9). If only the conifers are considered, 77 per cent of the volume is in the smaller size class and 23 per cent in the class 10 inches d.b.h. and over. Hardwoods are more equally divided, with 55 per cent in the 4–9 inch size class and 45 per cent in the 10 inch

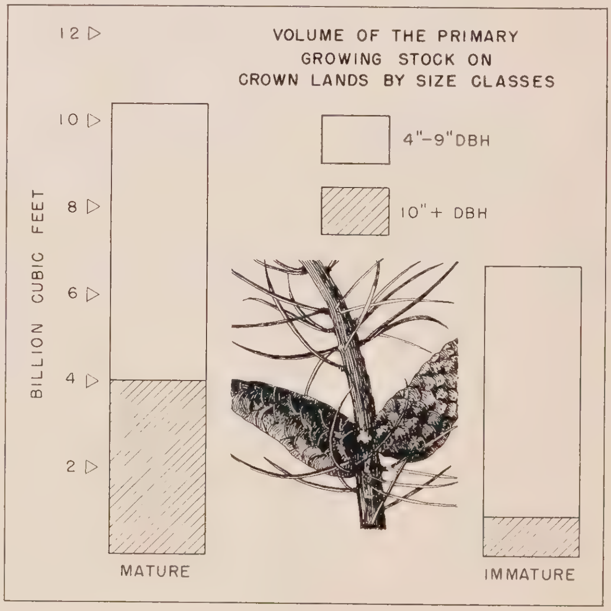


FIGURE 8

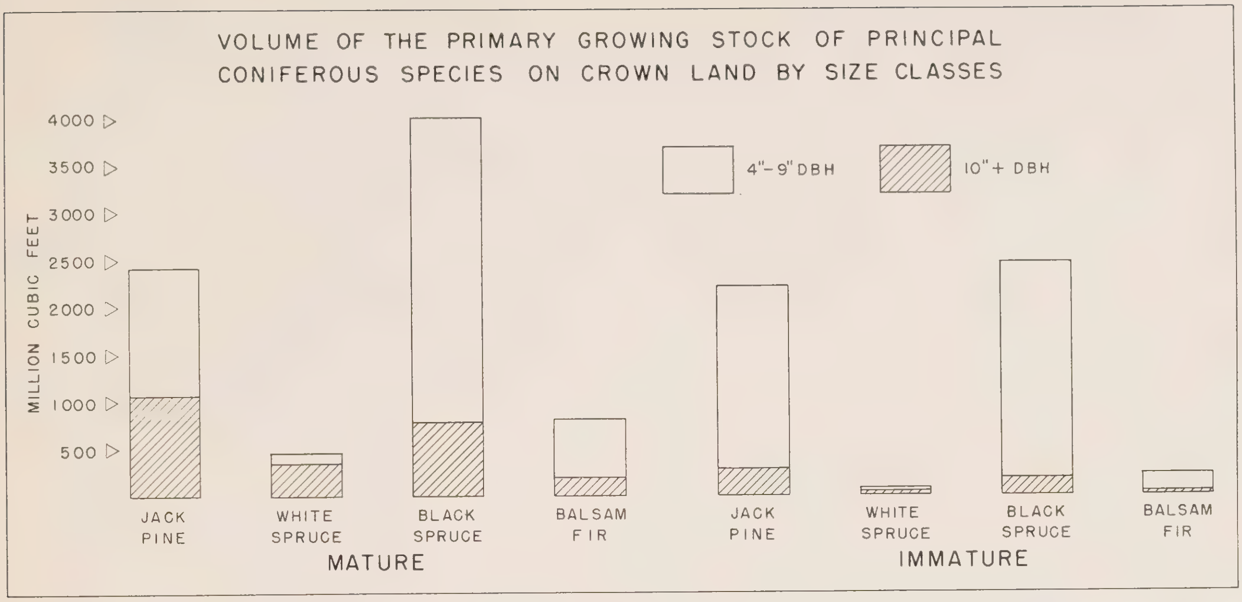


FIGURE 9

and over class. The mature age class on Crown lands has 6,435 million cubic feet or 62 per cent of its volume in the pulpwood class and 4,022 million cubic feet or 38 per cent of pulpwood or cordwood size (fig. 8).

In the mature forest on Crown land the sawlog size class contains 2,418 million cubic feet of conifers and 1,604 million cubic feet of hardwoods (table 9). Conifers comprise 60 per cent of the mature sawlog volume, while hardwoods form 40 per cent of the mature volume in this class.

Jack pine with 1,067 million cubic feet 10 inches d.b.h. and over has 44 per cent of the mature volume in the sawlog size class (fig. 9) and furnishes 44 per cent of the coniferous sawlog volume. Black spruce with 789 million cubic feet 10 inches d.b.h. and over has 20 per cent of the mature volume in the sawlog size class and furnishes 33 per cent of the coniferous sawlog volume. White spruce with 351 million cubic feet 10 inches d.b.h. and over has 76 per cent of the mature volume in the sawlog size class and furnishes 14 per cent of the mature sawlog volume. The balance of 9 per cent of the mature coniferous sawlog volume is made up of small quantities of balsam fir, white cedar and red and white pine. The main operable coniferous sawlog volumes are in jack pine and white spruce stands. The sawlog content of the black spruce stands is small in comparison to the pulpwood content and probably could not be recovered as sawlogs in commercial operations.

Poplar and white birch are the principal hardwood species in the district. Poplar with 1,305 million cubic feet of mature sawlog volume is the principal sawlog species in this age class producing 32 per cent of the total mature sawlog volume. In the mature age class 37 per cent of the white birch and 69 per cent of the poplar are of sawlog size (fig. 10).

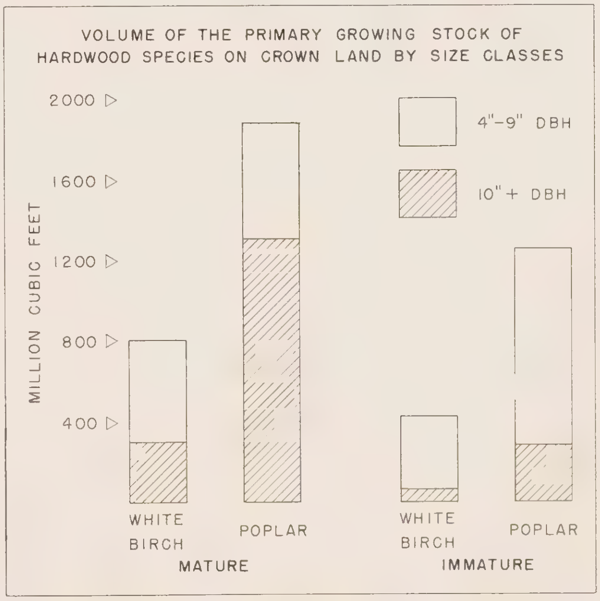


FIGURE 10

Table 5. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Sioux Lookout district by species groups, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	4,900,291	2,155,607	4,033,719	486,428	11,576,045
Hardwood........	181,998	152,865	332,236	48,485	715,584
Mixedwoods....	1,404,347	1,755,034	1,466,343	376,455	5,002,179
Total............	6,486,636	4,063,506	5,832,298	911,368	17,293,808

ALL CONIFERS

Cover type	Mature		Immature		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	4,590,703	1,742,048	3,739,682	381,787	10,454,220
Hardwood........	28,705	18,589	42,818	10,561	100,673
Mixedwoods....	771,622	678,060	706,342	169,761	2,325,785
Total............	5,391,030	2,438,697	4,488,842	562,109	12,880,678

ALL HARDWOODS

Cover type	Mature		Immature		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	309,588	413,559	294,037	104,641	1,121,825
Hardwood........	153,293	134,276	289,418	37,924	614,911
Mixedwoods....	632,725	1,076,974	760,001	206,694	2,676,394
Total............	1,095,606	1,624,809	1,343,456	349,259	4,413,130

Table 6. — *Cubic-foot volumes of primary growing stock on Crown land in the Sioux Lookout district by species groups, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	4,869,742	2,142,136	4,027,131	485,585	11,524,594
Hardwood........	181,064	152,162	330,397	48,236	711,859
Mixedwoods....	1,383,827	1,728,209	1,457,930	374,233	4,944,199
Total............	6,434,633	4,022,507	5,815,458	908,054	17,180,652

ALL CONIFERS

Cover type	Mature		Immature		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	4,562,114	1,731,505	3,733,536	381,162	10,408,317
Hardwood........	28,594	18,520	42,675	10,524	100,313
Mixedwoods....	759,526	668,089	702,105	168,746	2,298,466
Total............	5,350,234	[illegible],418,114	4,478,316	560,432	12,807,096

ALL HARDWOODS

Cover type	Mature		Immature		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous........	307,628	410,631	293,595	104,423	1,116,277
Hardwood........	152,470	133,642	287,722	37,712	611,546
Mixedwoods....	624,301	1,060,120	755,825	205,487	2,645,733
Total............	1,084,399	1,604,393	1,337,142	347,622	4,373,556

TABLE 7. — *Cubic-foot volumes of primary growing stock on patented land in the Sioux Lookout district by species groups, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	30,549	13,471	6,588	843	51,451
Hardwood	934	703	1,839	249	3,725
Mixedwoods	20,520	26,825	8,413	2,222	57,980
TOTAL	52,003	40,999	16,840	3,314	113,156

ALL CONIFERS

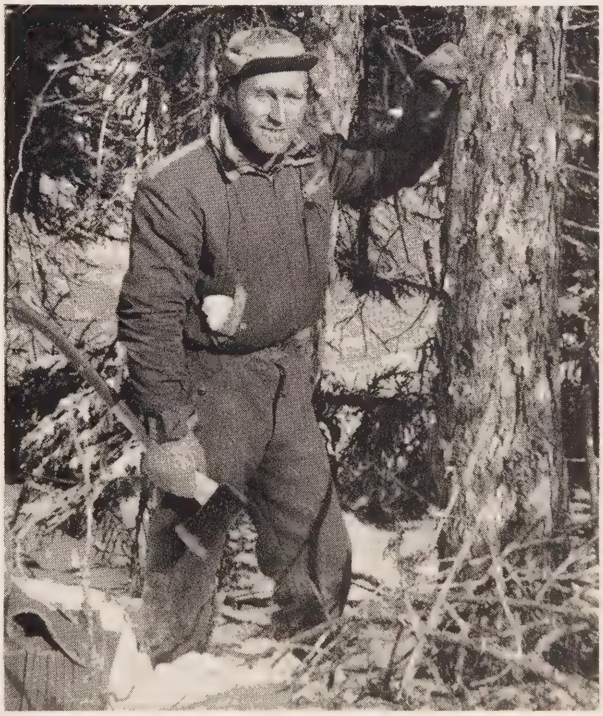
Cover type	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	28,589	10,543	6,146	625	45,903
Hardwood	111	69	143	37	360
Mixedwoods	12,096	9,971	4,237	1,015	27,319
TOTAL	40,796	20,583	10,526	1,677	73,582

ALL HARDWOODS

Cover type	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,960	2,928	442	218	5,548
Hardwood	823	634	1,696	212	3,365
Mixedwoods	8,424	16,854	4,176	1,207	30,661
TOTAL	11,207	20,416	6,314	1,637	39,574

TABLE 8. — *Cubic-foot volumes of primary growing stock on productive forest land in the Sioux Lookout district by species and age classes in two size classes.*

Species	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	Total all lands
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	....	656	382	209	1,247
Red pine	84	3,319	3,688	1,063	8,154
Jack pine	1,374,635	1,075,633	1,954,629	287,197	4,692,094
White spruce	114,584	354,071	39,111	43,632	551,398
Black spruce	3,265,965	796,221	2,299,057	186,821	6,548,064
Balsam fir	624,861	198,998	184,618	42,457	1,050,934
White cedar	10,887	9,784	411	418	21,500
Larch	14	15	6,946	312	7,287
TOTAL CONIFERS	5,391,030	2,438,697	4,488,842	562,109	12,880,678
White birch	510,790	303,641	364,970	63,771	1,243,172
Poplar	584,816	1,321,168	978,408	285,421	3,169,813
Other hardwoods	....	....	78	67	145
TOTAL HARDWOODS	1,095,606	1,624,809	1,343,456	349,259	4,413,130
TOTAL ALL SPECIES	6,486,636	4,063,506	5,832,298	911,368	17.293,808



Black spruce grows to large size on well-drained soils in the far northern parts of Ontario.

TABLE 9. — *Cubic-foot volumes of primary growing stock on Crown land in the Sioux Lookout district by species and age class in two size classes.*

Species	Mature		Immature		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	....	656	382	209	1,247
Red pine	84	3,317	3,688	1,063	8,152
Jack pine	1,363,743	1,067,173	1,950,124	286,336	4,667,376
White spruce	113,616	351,230	38,948	43,511	547,305
Black spruce	3,241,610	788,701	2,293,743	186,255	6,510,309
Balsam fir	620,304	197,248	184,089	42,329	1,043,970
White cedar	10,863	9,774	410	417	21,464
Larch	14	15	6,932	312	7,273
TOTAL CONIFERS	5,350,234	2,418,114	4,478,316	560,432	12,807,096
White birch	505,216	299,623	363,485	63,544	1,231,868
Poplar	579,183	1,304,770	973,581	284,012	3,141,546
Other hardwoods	....	....	76	66	142
TOTAL HARDWOODS	1,084,399	1,604,393	1,337,142	347,622	4,373,556
TOTAL ALL SPECIES	6,434,633	4,022,507	5,815,458	908,054	17,180,652

TABLE 10. — *Cubic-foot volumes of primary growing stock on patented land in the Sioux Lookout district by species and age class in two size classes.*

Species	Mature		Immature		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	....	....	....	....	....
Red pine	....	2	....	....	2
Jack pine	10,892	8,460	4,505	861	24,718
White spruce	968	2,841	163	121	4,093
Black spruce	24,355	7,520	5,314	566	37,755
Balsam fir	4,557	1,750	529	128	6,964
White cedar	24	10	1	1	36
Larch	....	....	14	....	14
TOTAL CONIFERS	40,796	20,583	10,526	1,677	73,582
White birch	5,574	4,018	1,485	227	11,304
Poplar	5,633	16,398	4,827	1,409	28,267
Other hardwoods	....	....	2	1	3
TOTAL HARDWOODS	11,207	20,416	6,314	1,637	39,574
TOTAL ALL SPECIES	52,003	40,999	16,840	3,314	113,156

Most modern transport medium used to open up the north country is the helicopter. This "whirlybird" is landing supplies for a survey crew.

Allowable Cut

The calculations of the allowable cut have been carried out for each species by means of a volumetric formula[1] using an appropriate rotation[2]. The amount of the annual allowable cut results directly from the volume of the primary growing stock and rotation used for the different species encountered in the district. The present allowable cut volumes, like the volume of the primary growing stock, may be on areas which, at the moment, are inaccessible to operations. The allowable cut volumes may likewise be in stands which, due to low net yield, are economically inoperable. Taking these conditions into account, the computed allowable cut is regarded as potential, rather than actually obtainable under present operating conditions.

Woods operations are being carried on each year and with present stands growing older, the size and structure of the primary growing stock will change. Hence the calculation of the allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. On expiration of the initial ten year period, the allowable cut should be calculated anew, based on the experience of the first ten year period and in conformity with the actual performance of the forest. With effective forestry practices allowable cuts for the more valuable species will tend, almost certainly, to increase.

Patented lands in the district cover 73,149 acres, about 0.5 per cent of the district area. Appearing in such a small proportion, the patented lands with their resources have no bearing on the process of regulating yield in the district.

The annual allowable cut, or net depletion allowable under management, in the Sioux Lookout district is 288,694,615 cubic feet, 286,632,795 cubic feet from Crown lands and 2,061,820 cubic feet from patented lands.

CROWN LAND

The annual allowable cut for Crown land represents 1.67 per cent of the primary growing stock or 25.7 cubic feet per acre of the productive forest area. Of the total allowable cut, 183,062,405 cubic feet, or 64 per cent, is coniferous species and 103,570,390 cubic feet, or 36 per cent, is of hardwood species. Since the rotation is on the average longer for conifers than for hardwoods, the annual allowable cut

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1 Methods of calculation of allowable cut are given in Appendix, allowable cut, page 25

2 Rotation by species, table 16, page 25.

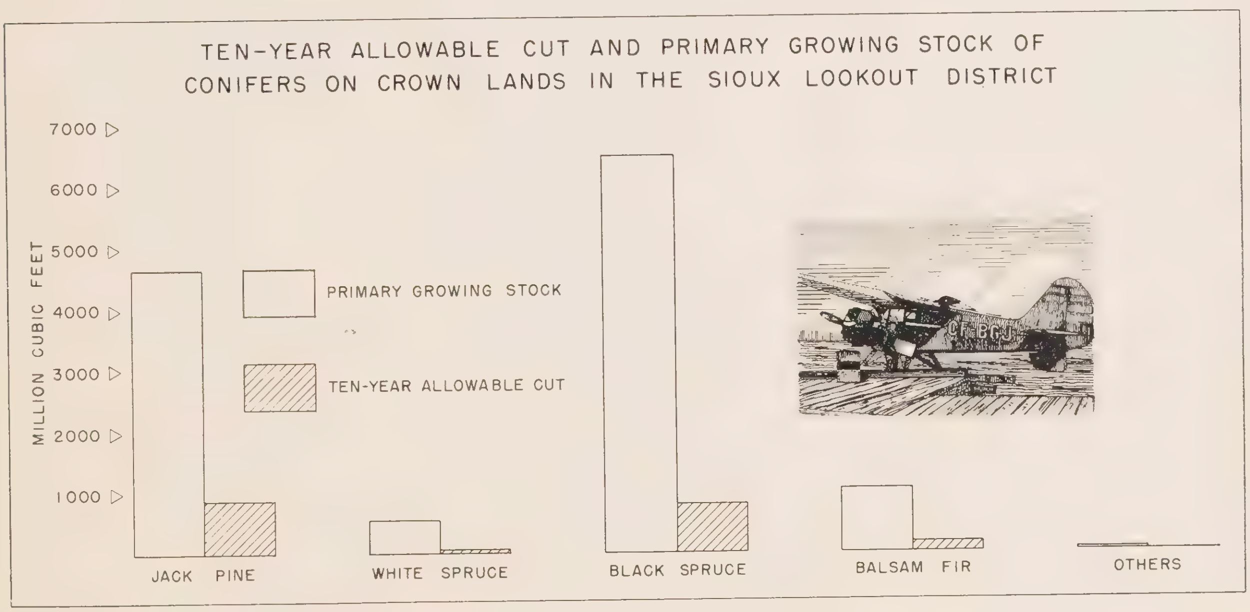


FIGURE 11

for conifers is 1.4 per cent of the coniferous primary growing stock and 2.4 per cent for the hardwoods.

The annual allowable cut for the species making up the coniferous content (table 11) shows that 48 per cent is jack pine, 43 per cent white and black spruce, and 9 per cent balsam fir. Other conifers contribute inappreciable volumes to the allowable cut. The relationship of the allowable cut for a ten year period to the volume of the primary growing stock by species is shown graphically, figure 11.

The species making up the hardwood content (table 12) shows that 80 per cent is poplar and that another 20 per cent is white birch. The relationship of the allowable cut for a ten year period to the volume of the primary growing stock for hardwoods by species is shown graphically, figure 12.

TABLE 11. — *Annual allowable cut for coniferous species on Crown lands in the Sioux Lookout district.*

Species	Annual allowable cut *cu. ft.*
White pine	13,750
Red pine	107,935
Jack pine	88,274,085
White spruce	7,245,825
Black spruce	71,825,530
Balsam fir	15,356,920
White cedar	142,080
Larch	96,280
TOTAL CONIFERS	183,062,405

TABLE 12. — *Annual allowable cut for hardwood species on Crown lands in the Sioux Lookout district.*

Species	Annual allowable cut *cu. ft.*
White birch	20,386,025
Poplar	83,182,485
Other hardwoods	1,880
TOTAL HARDWOODS	103,570,390

TABLE 13. — *Annual allowable cut for all species on patented lands.*

Species	Annual allowable cut *cu. ft.*
Red pine	30
Jack pine	487,605
White spruce	56,520
Black spruce	434,470
Balsam fir	106,865
White cedar	245
Larch	205
TOTAL CONIFERS	1,085,940
White birch	195,125
Poplar	780,710
Other hardwoods	45
TOTAL HARDWOODS	975,880
TOTAL	2,061,820

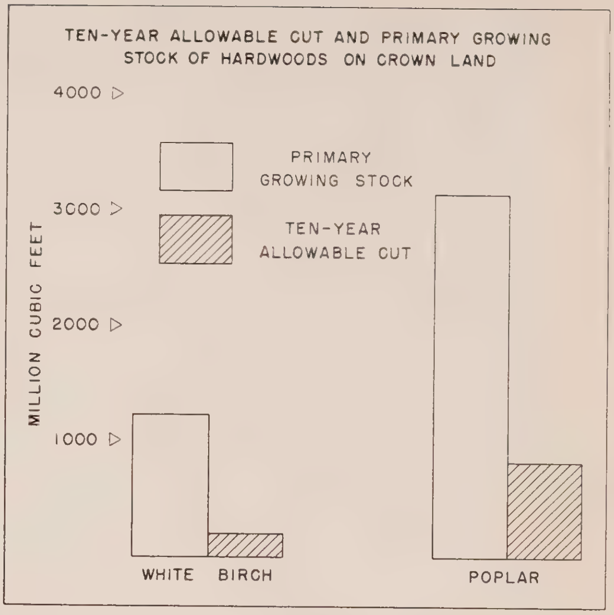
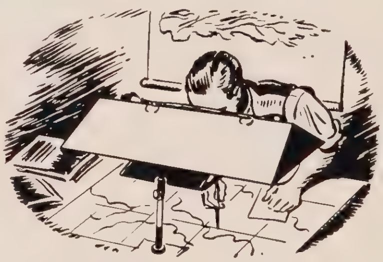


FIGURE 12

PATENTED LAND

The annual allowable cut for patented lands amounts to 2,061,820 cubic feet, 1,085,940 cubic feet of conifers and 975,880 cubic feet of hardwoods. The species content of the annual allowable cut on patented lands (table 13) shows similar percentage figures to those on Crown lands.



Utilization vs. Allowable Cut

According to the Classification of Annual Timber Returns for the period 1946–1949[1], the following annual average amounts of wood and forest products were cut on Crown lands in the Sioux Lookout district:

Logs and booms	10,089,710 F.B.M. Doyle rule
Dimension timber	80,440 lineal feet
Pulpwood	206,918 cords
Fuelwood	13,573 cords
Poles	3,102 pieces
Posts	191 pieces
Piling	101,044 lineal feet
Lagging	175,564 lineal feet
Lagging	49,828 cubic feet
Ties	88,564 lineal feet

[1] Reports of the Minister of Lands and Forests for the Province of Ontario for the fiscal years ending March 31, 1947–1950.

By the use of appropriate converting factors these amounts are expressed in gross total cubic feet (table 14) and are comparable with the figures for allowable cut (table 15).

TABLE 14. — *Gross total cubic volume of wood utilized annually in the Sioux Lookout district.*

Species	Wood utilized *cu. ft.*	Total *per cent*
Pine, white and red	213,421	1
Jack pine	8,636,468	28
Spruce, white and black	20,990,100	68
Balsam fir	1,043,697	3
TOTAL CONIFERS	30,883,686	100
White birch	2,195	*
Poplar	140,362	*
TOTAL HARDWOODS	142,557	*
TOTAL	31,026,243	100

* Less than one per cent.

A comparison of the annual allowable cut with the actual cut by species (table 15) indicates that the utilization on Crown lands in the district was only 11 per cent of the allowable cut. Mostly conifers were cut in the district, while excessive volumes of poplar and white birch remain unutilized. The only coniferous species which were cut over and above their allowable cut quota are white and red pine. This, however, is of no practical significance as both species contribute an inappreciable volume to the total allowable cut. The utilization of all other species was less than their allowable quota: 27 per cent of the allowable cut for white and black spruce was utilized, 10 per cent jack pine, 7 per cent balsam fir and only one-fifth of one per cent of poplar (fig. 13).

There are no available records on the quantity of timber utilized from patented lands in the Sioux Lookout district, and, consequently, no comparison of the allowable with the annual actual cut is made.

TABLE 15. — *Comparison of allowable cut with actual utilization by species.*

Species	Allowable cut *Thousand cu. ft.*	Actual cut *Thousand cu. ft.*
Pine, white and red	122	213
Jack pine	88,274	8,637
Spruce, white and black	79,072	20,990
Balsam fir	15,357	1,044
White cedar	142	
Larch	96	. .
TOTAL CONIFERS	183,063	30,884
White birch	20,386	2
Poplar	83,182	140
Other hardwoods	2	. . .
TOTAL HARDWOODS	103,570	142
TOTAL	286,633	31,026

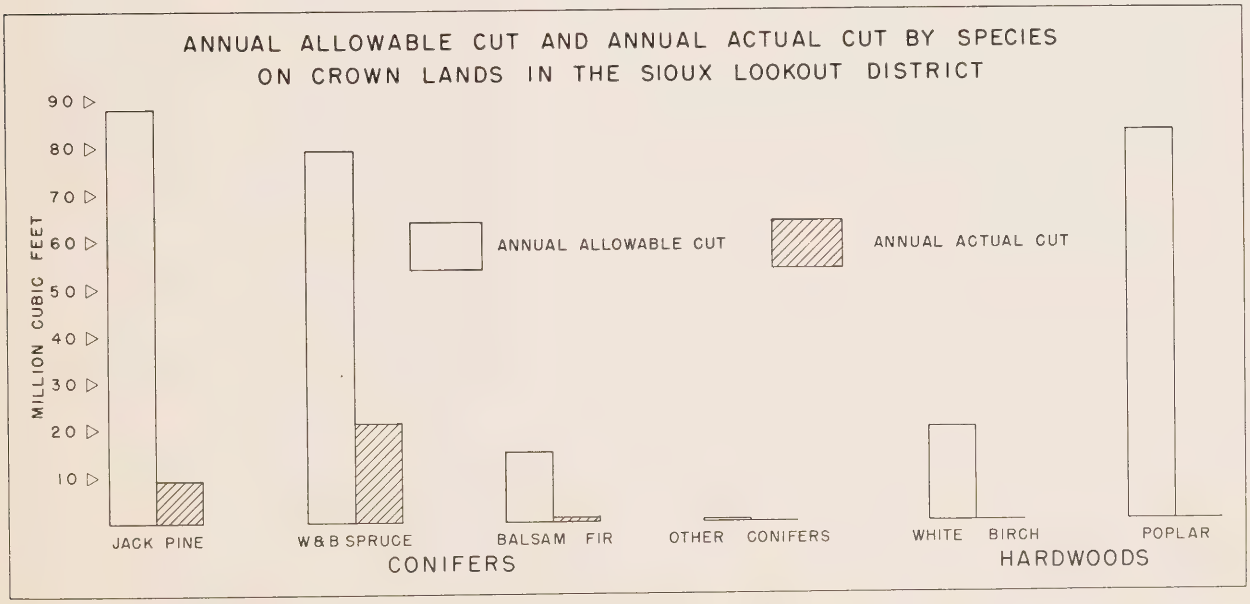


FIGURE 13

APPENDIX

Survey Methods

● The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs on a scale of four inches to the mile (1/15,840). Following the photography, planimetric base maps were prepared by the Slotted Templet Method. Forest type maps were made by direct photographic interpretation on stereoscopic pairs of photographs and transferred to the base maps.

Systematic sampling was carried out by field crews who collected all of the data necessary for making volume estimates. On completion of the field work, finished forest type maps were prepared and areas determined by the usual methods.[1] Field sampling was carried out for the Sioux Lookout district during the summers of 1949, 1950, 1951, 1952 and 1953.

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. These were separated into two age classes, mature and immature. The volume per acre of each cover type for the mature and immature age classes was then summarized from the field tallies into four density classes. These summaries were made separately for the four ecological sections in the Sioux Lookout district. The per acre volumes in cubic feet, made up in this manner, are shown in tables 18, 19 and 20. Additional tables covering the Western Transition section 1950 and 1951 and the English River section 1952 may be found in Report No. 15 of the Kenora district, and tables for the Central Plateau section 1949 are contained in Report No. 6 of the Port Arthur district.

The holder of a licence to cut timber on Crown lands in Ontario is required by Statute to supply a complete inventory of the timber resources on the licensed area. The forest resources inventory of the Sioux Lookout district is therefore made up of a combination of surveys carried out by the Department of Lands and Forests and company surveys. The areas surveyed by licensees in the Sioux Lookout district are shown in figure 14.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by taking the total mature volume for each species and dividing by the rotation age for the species. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 26 cubic feet per acre, and for patented lands, 32 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculation.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield because there are no figures for areas by species. The immature age class may have an age range from 10 to 100 years, the mature age class from 30 to 200 years, depending on species. Therefore, no normal area for each age class can be arrived at.

[1] A complete statement of the methods used in the inventory will be found in Manual of Timber Management, Department of Lands and Forests, Ontario, Part II and Part III.

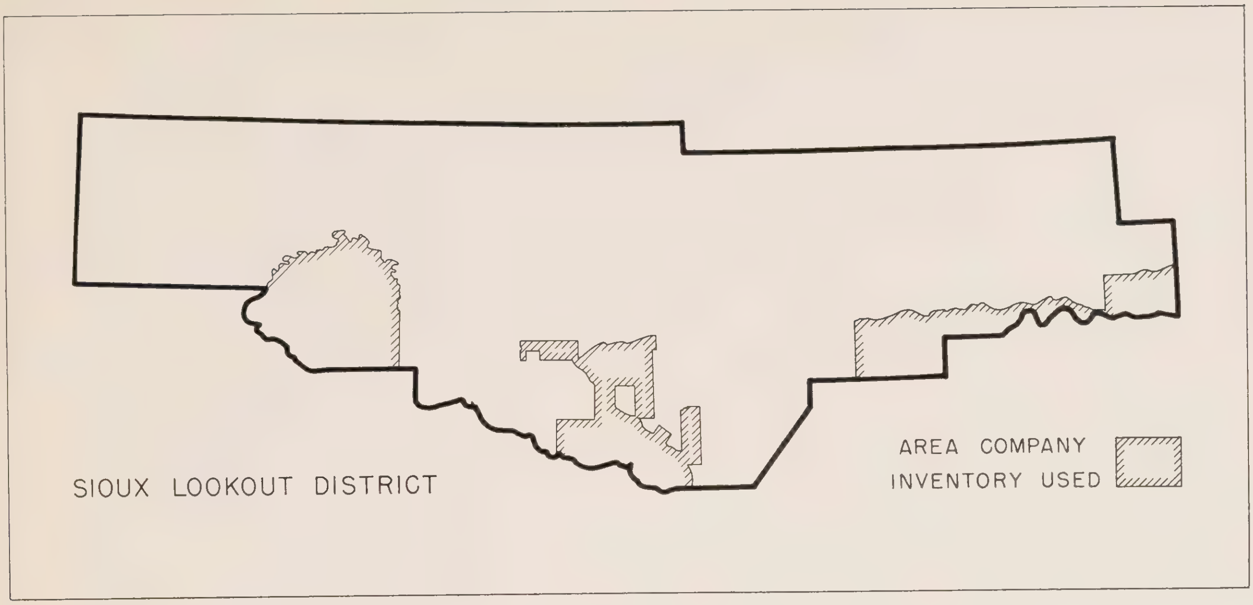


FIGURE 14

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class 1b[1] were used as rotation ages for each species encountered except jack pine, where a rotation of 70 years has been accepted as more suitable than 60 years (table 16).

TABLE 16. — *Rotation by species.*

Species	Crown and patented land
	years
White pine	120
Red pine..	100
Jack pine	70
White spruce	100
Black spruce	120
Balsam fir	90
White cedar	200
Larch	100
White birch	80
Poplar	50

Allowable Cut

(a) METHOD

The following two bases were available for calculation of allowable cut: 1. the volumes of the mature and immature age classes for each species and 2. the adopted rotation.

The compilation was carried out in such a way that the volumes were shown by species. This suggests the calculation of the allowable cut by individual species, separately, rather than for the total primary stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[1] was considered and found to be satisfactory, for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was actually found, so far in Ontario, to be approximately 5/3 required by the French method. 2. In compilation, three age classes were used, the same number which the proposed French method requires, although the division into thirds is not exactly the same. 3. The French method is recognized as sound enough though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends toward building up a normal growing stock, and the results of calculations may be considered as rather conservative.

(b) FORMULA

In the present calculations the following formula was used:

$$P = \frac{5/8\ (V.1. + V.2.)}{n/3}$$

where:

V.1. — denotes volume of mature timber (Age Class I)
V.2. — denotes volume of immature timber (Age Class II)
n — denotes rotation
P — denotes annual allowable cut

[1] Manual of Timber Management, Department of Lands and Forests, Ontario — Part II, page 50.

[1] "Le traité pratique d'aménagement des forêts" — L. Pardé, 1930, Paris.

By application of this formula, the following figures for the annual allowable cut were obtained:

Crown land	405,946,400 cubic feet
Patented land	2,799,485 cubic feet
TOTAL	408,745,885 cubic feet

This may be regarded as the maximum annual allowable cut for the district, fully justified if need of intensive utilization was substantiated by the present operations in the district. As may be seen from table 14, the actually utilized annual volume was only 31,026,243 cubic feet on Crown lands, or less than 8 per cent of 405,946,400 cubic feet of the maximum annual allowable cut on the Crown land in the Sioux Lookout district.

With rather a moderate demand on wood in view, and with considerable accumulation of mature timber in the district, an advantageous opportunity arises, where by means of a normal, and not the maximum, utilization the normal size of age classes may be obtained; thus a sound foundation would be created for a balanced sustained yield in the future.

During the period of a gradual, and not radical, normalization of age class areas a portion of mature and overmature stands will be held over and above their mature age. This involves certain losses in volume of those stands where progressing cull may not be balanced by volume increment of ageing stands. These losses, however, are not expected to be of importance, inasmuch as the bulk of valuable stands is made of spruce not readily given to decay.

In view of the foregoing, the calculations of the annual allowable cut carried out on the French method principles, were brought to the normal level, according to the following procedure:

CROWN LANDS

Productive forest area = 11,162,763 acres
Age Class I volume per acre = 2054.20 cubic feet
Mean annual increment to the rotation age = 25.52 cubic feet

Thus the average rotation $= \frac{2054.20}{25.52} = 80$ years.

Normal area allotment $= \frac{11,162,763}{80} = 139,535$ acres

Normal allowable cut $= 139,535 \times 2054.20 = 286,632,795$ cubic feet.

PATENTED LANDS

Productive forest area = 65,528 acres
Age Class I volume per acre = 2422.82 cubic feet
Mean annual increment to the rotation age = 31.55 cubic feet

Thus the average rotation $= \frac{2422.82}{31.55} = 77$ years

Normal area allotment $= \frac{65,528}{77} = 851$ acres

Normal allowable cut $= 851 \times 2422.82 = 2,061,820$ cubic feet.

Cull Factor

Where it was found necessary either to calculate net merchantable volumes or to calculate the volume of the primary growing stock when merchantable volumes only were given in company reports, the appropriate cull factors (table 17) were used throughout. These cull factors were taken from the figures for defect made available from operations being carried out in the district.

TABLE 17. — *Cull factors by species, Sioux Lookout district.*

Species	Cull *per cent*
White pine	20
Red Pine	20
Jack pine	15
White spruce	10
Black spruce	10
Balsam fir	33
White birch	25
Poplar	40

Common and Botanical Names of Tree Species included in Timber Estimates

CONIFERS

White pine . . . . . *Pinus strobus L.*
Red pine . . . . . *Pinus resinosa Ait.*
Jack pine . . . . . *Pinus banksiana Lamb.*
White spruce . . . . . *Picea glauca (Moench) Voss.*
Black spruce . . . . . *Picea mariana (Mill.) BSP.*
Balsam fir . . . . . *Abies balsamea (L.) Mill.*
White cedar . . . . . *Thuja occidentalis L.*
Larch . . . . . *Larix laricina (Du Roi) Koch.*

HARDWOODS

Black ash . . . . . *Fraxinus nigra Marsh.*
White birch . . . . . *Betula papyrifera Marsh.*
Poplar . . . . . *Populus tremuloides Michx.*
Populus tacamahacca Mill.
Populus grandidentata Michx.

TABLE 18. — *Volume of the primary growing stock in cubic feet per acre*

Central Plateau Section — 1951

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)				CONIFEROUS IMMATURE (C-II)			
		DENSITY CLASS				DENSITY CLASS			
		1	2	3	4	1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Jack pine	4″–9″	473.3	457.4	394.0	294.7	597.9	572.8	412.8	224.7
	10″ up	203.8	197.0	169.6	143.2	57.7	55.3	39.8	
Black spruce	4″–9″	986.3	953.2	821.0	255.5	762.5	730.5	526.4	199.8
	10″ up	137.0	132.4	114.1	52.0	43.5	41.7	30.0	....
Balsam fir	4″–9″	41.3	40.0	34.4	....	....			
	10″ up	9.1	8.8	7.6	....	....	....	....	
Larch	4″–9″	....	....	....	....	3.1	3.0	2.2	....
	10″ up								
TOTAL CONIFERS	4″–9″	1500.9	1450.6	1249.4	550.2	1363.5	1306.3	941.4	424.5
	10″ up	349.9	338.2	291.3	195.2	101.2	97.0	69.8	....
White birch	4″–9″	38.4	37.1	32.0	25.0	42.8	40.9	29.4	20.5
	10″ up	12.0	11.6	10.0	....	2.2	2.2	1.6	....
Poplar (all)	4″–9″	27.1	26.2	22.6	34.6	35.1	33.6	24.2	....
	10″ up	11.7	11.3	9.7	....	5.2	5.0	3.6	....
TOTAL HARDWOODS	4″–9″	65.5	63.3	54.6	59.6	77.9	74.5	53.6	20.5
	10″ up	23.7	22.9	19.7	....	7.4	7.2	5.2	
GRAND TOTAL	4″–9″	1566.4	1513.9	1304.0	609.8	1441.4	1380.8	995.0	445.0
	10″ up	373.6	361.1	311.0	195.2	108.6	104.2	75.0	....
TOTAL 4″ UP		1940.0	1875.0	1615.0	805.0	1550.0	1485.0	1070.0	445.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
Jack pine	4″–9″	49.5	47.3	38.0	17.4	78.9	74.4	54.6	21.1
	10″ up	94.3	90.3	72.5	33.3	22.1	20.9	15.3	5.9
White spruce	4″–9″	15.0	14.3	11.5	5.3	....	....		
	10″ up	21.8	20.9	16.8	7.7	....	....	....	....
Black spruce	4″–9″	185.4	177.4	142.5	65.4	58.0	54.7	40.1	15.5
	10″ up	32.0	30.6	24.5	11.3	....	....	....	
Balsam fir	4″–9″	80.0	76.6	61.5	28.2	4.8	4.6	3.4	1.3
	10″ up	33.7	32.2	25.9	11.9	4.5	4.2	3.1	1.2
TOTAL CONIFERS	4″–9″	329.9	315.6	253.5	116.3	141.7	133.7	98.1	37.9
	10″ up	181.8	174.0	139.7	64.2	26.6	25.1	18.4	7.1
White birch	4″–9″	439.1	420.0	337.3	154.9	245.2	231.4	169.8	65.6
	10″ up	86.1	82.4	66.2	30.4	27.8	26.3	19.3	7.4
Poplar (all)	4″–9″	1117.1	1068.7	858.3	394.1	1301.5	1228.5	901.3	348.0
	10″ up	1191.0	1139.3	915.0	420.1	127.2	120.0	88.1	34.0
TOTAL HARDWOODS	4″–9″	1556.2	1488.7	1195.6	549.0	1546.7	1459.9	1071.1	413.6
	10″ up	1277.1	1221.7	981.2	450.5	155.0	146.3	107.4	41.4
GRAND TOTAL	4″–9″	1886.1	1804.3	1449.1	665.3	1688.4	1593.6	1169.2	451.5
	10″ up	1458.9	1395.7	1120.9	514.7	181.6	171.4	125.8	48.5
TOTAL 4″ UP		3345.0	3200.0	2570.0	1180.0	1870.0	1765.0	1295.0	500.0

(*Continued on page 28*)

TABLE 18 (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I)				MIXEDWOODS IMMATURE (M-II)			
		DENSITY CLASS				DENSITY CLASS			
		1	2	3	4	1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Jack pine	4″–9″	228.3	220.4	184.3	....	387.4	364.2	263.7	104.1
	10″ up	324.5	313.3	261.9	....	54.8	51.6	37.3	14.7
White spruce	4″–9″	10.4	10.0	8.4	....	....	....	....	....
	10″ up	83.1	80.3	67.1	....	....	....	....	....
Black spruce	4″–9″	307.5	296.9	248.3	400.0	323.6	304.3	220.2	87.0
	10″ up	173.7	167.7	140.2	....	33.2	31.2	22.6	8.9
Balsam fir	4″–9″	129.3	124.8	104.3	....	8.4	7.9	5.7	2.2
	10″ up	60.5	58.4	48.9	....	....	....	....	....
Larch	4″–9″	....	....	....	....	1.7	1.6	1.1	0.4
	10″ up	....	....	....	....	....	....	....	....
TOTAL CONIFERS	4″–9″	675.5	652.1	545.3	400.0	721.1	678.0	490.7	193.7
	10″ up	641.8	619.7	518.1	....	88.0	82.8	59.9	23.6
White birch	4″–9″	336.5	324.9	271.6	605.8	205.8	193.5	140.1	55.3
	10″ up	230.0	222.0	185.7	84.2	13.6	12.8	9.3	3.7
Poplar (all)	4″–9″	328.3	317.0	265.0	....	585.7	550.8	398.6	157.4
	10″ up	537.9	519.3	434.3	....	60.8	57.1	41.4	16.3
TOTAL HARDWOODS	4″–9″	664.8	641.9	536.6	605.8	791.5	744.3	538.7	212.7
	10″ up	767.9	741.3	620.0	84.2	74.4	69.9	50.7	20.0
GRAND TOTAL	4″–9″	1340.3	1294.0	1081.9	1005.8	1512.6	1422.3	1029.4	406.4
	10″ up	1409.7	1361.0	1138.1	84.2	162.4	152.7	110.6	43.6
TOTAL 4″ UP		2750.0	2655.0	2220.0	1090.0	1675.0	1575.0	1140.0	450.0

Survey line in mixed and coniferous pulpwood stands in far northern Ontario.

TABLE 19. — *Volume of the primary growing stock in cubic feet per acre.*
Northern Coniferous Section — 1952 and 1953

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)				CONIFEROUS IMMATURE (C-II)			
		DENSITY CLASS				DENSITY CLASS			
		1	2	3	4	1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Jack pine	4″–9″	579.0	530.9	415.4	172.0	764.4	676.6	454.0	156.1
	10″ up	302.3	277.2	216.9	83.9	81.2	71.8	48.2	177.4
White spruce	4″–9″	22.8	20.9	16.4	6.2	....	....	....	....
	10″ up	43.4	39.8	31.1	130.5	....	....	....	....
Black spruce	4″–9″	1266.6	1161.4	908.7	311.9	1336.8	1183.2	793.9	160.3
	10″ up	324.6	297.6	232.9	56.3	127.4	112.7	75.7	18.0
Balsam fir	4″–9″	107.3	98.4	77.0	95.4	54.1	47.9	32.1	12.6
	10″ up	34.1	31.2	24.4	80.6	16.4	14.5	9.7	2.9
TOTAL CONIFERS	4″–9″	1975.7	1811.6	1417.5	585.5	2155.3	1907.7	1280.0	329.0
	10″ up	704.4	645.8	505.3	351.3	225.0	199.0	133.6	198.3
White birch	4″–9″	69.6	63.8	49.9	36.7	59.1	52.4	35.1	20.0
	10″ up	35.7	32.7	25.6	98.8	11.4	10.0	6.7	8.2
Poplar (all)	4″–9″	62.8	57.6	45.0	14.5	85.6	75.8	50.9	14.3
	10″ up	159.8	146.5	114.7	71.2	73.6	65.1	43.7	5.2
TOTAL HARDWOODS	4″–9″	132.4	121.4	94.9	51.2	144.7	128.2	86.0	34.3
	10″ up	195.5	179.2	140.3	170.0	85.0	75.1	50.4	13.4
GRAND TOTAL	4″–9″	2108.1	1933.0	1512.4	636.7	2300.0	2035.9	1366.0	363.3
	10″ up	899.9	825.0	645.6	521.3	310.0	274.1	184.0	211.7
TOTAL 4″ UP		3008.0	2758.0	2158.0	1158.0	2610.0	2310.0	1550.0	575.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
Jack pine	4″–9″	170.9	146.2	96.1	18.5	110.0	90.1	56.6	19.7
	10″ up	112.1	95.9	63.0	....	5.7	4.6	2.9	1.0
White spruce	4″–9″	60.4	51.7	34.0	2.0	22.5	18.4	11.5	4.0
	10″ up	56.7	48.5	31.9	....	23.8	19.5	12.3	4.3
Black spruce	4″–9″	135.2	115.7	76.1	43.8	75.2	61.5	38.6	13.4
	10″ up	16.0	13.7	9.0	19.5	....	....	....	....
Balsam fir	4″–9″	41.7	35.6	23.4	....	23.8	19.5	12.2	4.3
	10″ up	31.5	27.0	17.8	....	25.3	20.7	13.1	4.5
TOTAL CONIFERS	4″–9″	408.2	349.2	229.6	64.3	231.5	189.5	118.9	41.4
	10″ up	216.3	185.1	121.7	19.5	54.8	44.8	28.3	9.8
White birch	4″–9″	483.6	413.7	271.9	99.3	139.6	114.2	71.7	25.0
	10″ up	209.2	179.0	117.7	73.1	10.8	8.9	5.6	1.9
Poplar (all)	4″–9″	1991.0	1703.3	1119.7	143.6	2037.9	1668.0	1047.9	364.3
	10″ up	1570.7	1343.7	883.4	574.2	417.4	341.6	214.6	74.6
TOTAL HARDWOODS	4″–9″	2474.6	2117.0	1391.6	242.9	2177.5	1782.2	1119.6	389.3
	10″ up	1779.9	1522.7	1001.1	647.3	428.2	350.5	220.2	76.5
GRAND TOTAL	4″–9″	2882.8	2466.2	1621.2	307.2	2409.0	1971.7	1238.5	430.7
	10″ up	1996.2	1707.8	1122.8	666.8	483.0	395.3	248.5	86.3
TOTAL 4″ UP		4879.0	4174.0	2744.0	974.0	2892.0	2367.0	1487.0	517.0

(Continued on page 30)

TABLE 19 (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I)				MIXEDWOODS IMMATURE (M-II)			
		DENSITY CLASS				DENSITY CLASS			
		1	2	3	4	1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Jack pine	4″–9″	214.0	201.5	155.4	23.8	446.6	392.9	258.2	401.5
	10″ up	318.3	299.8	231.1	73.4	146.5	128.9	84.7	....
White spruce	4″–9″	45.4	42.7	33.0	15.5	16.0	14.1	9.2	....
	10″ up	147.8	139.2	107.3	294.4	37.1	32.6	21.5	....
Black spruce	4″–9″	543.2	511.5	394.4	130.3	524.3	461.2	303.1	36.3
	10″ up	265.1	249.7	192.5	108.7	98.4	86.6	56.9	....
Balsam fir	4″–9″	201.0	189.2	145.9	116.3	57.3	50.4	33.1	....
	10″ up	86.9	81.8	63.1	18.9	22.4	19.7	13.0	....
TOTAL CONIFERS	4″–9″	1003.6	944.9	728.7	285.9	1044.2	918.6	603.6	437.8
	10″ up	818.1	770.5	594.0	495.4	304.4	267.8	176.1	....
White birch	4″–9″	350.0	329.6	254.1	131.4	187.7	165.1	108.5	49.5
	10″ up	265.1	249.6	192.5	212.6	36.6	32.2	21.1	....
Poplar (all)	4″–9″	326.8	307.8	237.3	22.3	1007.4	886.2	582.4	88.7
	10″ up	1179.4	1110.6	856.4	165.4	370.7	326.1	214.3	....
TOTAL HARDWOODS	4″–9″	676.8	637.4	491.4	153.7	1195.1	1051.3	690.9	138.2
	10″ up	1444.5	1360.2	1048.9	378.0	407.3	358.3	235.4	....
GRAND TOTAL	4″–9″	1680.4	1582.3	1220.1	439.6	2239.3	1969.9	1294.5	576.0
	10″ up	2262.6	2130.7	1642.9	873.4	711.7	626.1	411.5	....
TOTAL 4″ UP		3943.0	3713.0	2863.0	1313.0	2951.0	2596.0	1706.0	576.0

Helicopter approaching the landing site.

Table 20. — *Volume of the primary growing stock in cubic feet per acre.*

Western Transition Section — 1953

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)				CONIFEROUS IMMATURE (C-II)			
		Density Class				Density Class			
		1	2	3	4	1	2	3	4
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
Jack pine	4″–9″	316.2	290.5	218.2	90.0	816.5	744.7	517.3	206.1
	10″ up	286.0	262.9	197.4	81.4	33.1	30.2	21.0	21.1
White spruce	4″–9″	28.3	26.0	19.5	8.1	8.6	7.8	5.5	....
	10″ up	138.2	127.0	95.4	39.3	10.2	9.3	6.4	2.2
Black spruce	4″–9″	1024.8	941.7	707.2	291.8	588.3	536.6	372.9	113.1
	10″ up	229.5	210.9	158.4	65.3	25.8	23.5	16.3	16.8
Balsam fir	4″–9″	321.2	295.1	221.6	91.4	50.4	46.0	31.9	16.6
	10″ up	89.5	82.3	61.8	25.5	12.7	11.6	8.1	....
Total Conifers	4″–9″	1690.5	1553.3	1166.5	481.3	1463.8	1335.1	927.6	335.8
	10″ up	743.2	683.1	513.0	211.5	81.8	74.6	51.8	40.1
White birch	4″–9″	91.8	84.4	63.4	26.2	37.2	33.9	23.6	....
	10″ up	58.0	53.3	40.0	16.5	10.6	9.7	6.7	20.0
Poplar (all)	4″–9″	39.8	36.6	27.5	11.3	100.8	91.9	63.8	18.1
	10″ up	151.7	139.3	104.6	43.2	11.8	10.8	7.5	22.0
Total Hardwoods	4″–9″	131.6	121.0	90.9	37.5	138.0	125.8	87.4	18.1
	10″ up	209.7	192.6	144.6	59.7	22.4	20.5	14.2	42.0
GRAND TOTAL	4″–9″	1822.1	1674.3	1257.4	518.8	1601.8	1460.9	1015.0	353.9
	10″ up	952.9	875.7	657.6	271.2	104.2	95.1	66.0	82.1
TOTAL 4″ UP		2755.0	2555.0	1915.0	790.0	1706.0	1556.0	1081.0	436.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
Jack pine	4″–9″	74.7	66.2	49.1	....	44.2	40.3	30.7	65.4
	10″ up	13.3	11.8	8.7	40.0	16.3	14.8	11.3	29.4
White spruce	4″–9″	36.7	32.5	24.1	4.7	1.3	1.2	0.9	....
	10″ up	43.3	38.4	28.4	....	8.2	7.4	5.7	....
Black spruce	4″–9″	76.0	67.4	49.9	9.4	43.5	39.6	30.1	16.0
	10″ up	....	....	....					
Balsam fir	4″–9″	20.0	17.7	13.1	4.7	5.4	4.9	3.7	9.1
	10″ up	....	....	....		2.2	2.0	1.5	
Total Conifers	4″–9″	207.4	183.8	136.2	18.8	94.4	86.0	65.4	90.5
	10″ up	56.6	50.2	37.1	40.0	26.7	24.2	18.5	29.4
White birch	4″–9″	260.9	231.2	171.2	164.3	216.4	197.0	150.1	209.6
	10″ up	7.2	6.4	4.7	562.5	8.6	7.8	5.9	
Poplar (all)	4″–9″	2292.9	2032.2	1505.0	6.6	1459.9	1328.7	1012.2	241.5
	10″ up	1176.0	1042.2	771.8	383.8	85.0	77.3	58.9	
Total Hardwoods	4″–9″	2553.8	2263.4	1676.2	170.9	1676.3	1525.7	1162.3	451.1
	10″ up	1183.2	1048.6	776.5	946.3	93.6	85.1	64.8	
GRAND TOTAL	4″–9″	2761.2	2447.2	1812.4	189.7	1770.7	1611.7	1227.7	541.6
	10″ up	1239.8	1098.8	813.6	986.3	120.3	109.3	83.3	29.4
TOTAL 4″ UP		4001.0	3546.0	2626.0	1176.0	1891.0	1721.0	1311.0	571.0

(*Continued on page 32*)

Table 20 (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) Density Class 1	2	3	4	MIXEDWOODS IMMATURE (M-II) Density Class 1	2	3	4
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
Jack pine	4″–9″	142.4	134.9	105.6	5.3	392.7	368.8	285.3	191.2
	10″ up	193.4	183.2	143.4	83.7	69.8	65.6	50.8	59.4
White spruce	4″–9″	77.4	73.3	57.4	23.2	19.5	18.3	14.2	....
	10″ up	188.6	178.7	139.8	143.8	23.3	21.9	16.9	....
Black spruce	4″–9″	375.6	355.8	278.4	44.0	243.5	228.7	176.9	89.3
	10″ up	106.5	101.0	79.0	....	16.6	15.6	12.1	64.4
Balsam fir	4″–9″	259.3	245.6	192.2	99.0	61.4	57.6	44.6	....
	10″ up	99.8	94.6	74.0	101.0	7.7	7.3	5.6	....
Total Conifers	4″–9″	854.7	809.6	633.6	171.5	717.1	673.4	521.0	280.5
	10″ up	588.3	557.5	436.2	328.5	117.4	110.4	85.4	123.8
White birch	4″–9″	329.9	312.5	244.5	75.3	200.0	187.9	145.3	59.9
	10″ up	112.3	106.4	83.3	246.7	25.5	23.9	18.5	....
Poplar (all)	4″–9″	466.5	441.9	345.8	34.7	536.2	503.6	389.6	56.8
	10″ up	973.3	922.1	721.6	143.3	49.8	46.8	36.2	....
Total Hardwoods	4″–9″	796.4	754.4	590.3	110.0	736.2	691.5	534.9	116.7
	10″ up	1085.6	1028.5	804.9	390.0	75.3	70.7	54.7	....
GRAND TOTAL	4″–9″	1651.1	1564.0	1223.9	281.5	1453.3	1364.9	1055.9	397.2
	10″ up	1673.9	1586.0	1241.1	718.5	192.7	181.1	140.1	123.8
TOTAL 4″ UP		3325.0	3150.0	2465.0	1000.0	1646.0	1546.0	1196.0	521.0

The survey crew.

Hon. Welland S. Gemmell

Minister

F. A. MacDougall

Deputy Minister

Report No. 17 of the
KEMPTVILLE DISTRICT

Forest Resources Inventory

— 1957 —

Division of Timber Management

Ontario Department of Lands and Forests

Forest Resources Inventory

— 1957 —

Report No. 17 of the

KEMPTVILLE DISTRICT

Division of Timber Management

Ontario Department of Lands and Forests

PREFACE

• In little more than a century, Southern Ontario has been transformed from an area of virgin forest into an agricultural and industrial region. The forest, to the early settlers, was regarded as an enemy that encroached upon the lands they required for farms and communities and formed a physical barrier between the isolated settlements. The abundance of wood and the scarcity of markets led to the belief that the supply of wood was inexhaustible. These attitudes, so inimical to forestry, persisted until recent times and, even now, have not completely disappeared.

Forests, mainly farm woodlots, now cover only a small portion of Southern Ontario and, in most instances, are so reduced in size that they no longer fulfil many of their normal attributes. Historical evidence to prove the deterioration of soil and physical condition which follow on the destruction of forests is overwhelmingly conclusive. The process of deterioration is usually very similar. Forests are cleared for the expansion of agriculture or the exploitation of other resources, and the remaining forests are progressively degraded through unwise cutting, excessive grazing, and fires. On vulnerable soils and sites these practices lead to: cumulative erosion by wind and water; loss of the surface soil; deposition of erosion debris on fertile agricultural soils; reduction in the storage capacity of the soil; silting of irrigation works and the spread of aridity. The ultimate result of such a process is the destruction of the physical bases of life, the formation of a desert, and the extinction of local civilization.

It is, therefore, no exaggeration to say that the reclamation of the unproductive and sub-marginal areas, and the preservation and improvement of existing woodlands, are matters of great importance to Ontario. The extension of the province-wide survey of the forest resources of Ontario to include these southern agricultural areas may be regarded as the first step in a programme of forest management and development.

The survey was authorized in 1952, and work was started by the Division of Timber Management early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement with the Province pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Department of Lands and Forests has set up twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the seventeenth in the series, deals with the results of the inventory in the Kemptville district.

Although the report deals primarily with the physical resources, the underlying purpose has been to measure the capacity of the forest to contribute to community employment and welfare, and to the industrial and commercial development of the Province as a whole. At the same time the report supplies the essential data for the planning of the long-term management of the forest resources.

CONTENTS

FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Kemptville district, excluding land administered by the Federal Government, is 3,329,488 acres, or 5,202 square miles. Inland water surface covers three per cent of this area.

2. The total land area of the district is 3,240,940 acres. Forested land occupies 22.8 per cent and is made up of 15.9 per cent productive forest and 6.9 per cent non-productive forest. Agricultural land forms 73.8 per cent of the total land area. It has been classed as 51.6 per cent developed agricultural land, 15.5 per cent grass and meadow and 6.7 per cent wooded pasture. The remaining 3.4 per cent has been grouped under other areas and includes Federal lands, roads, gravel-pits, power lines, towns and cities.

3. Only 4 per cent of the district remains under Crown ownership. For the purposes of this report, Municipal and County Forests, which are administered under an agreement with the Minister of Lands and Forests, are treated as Crown lands.

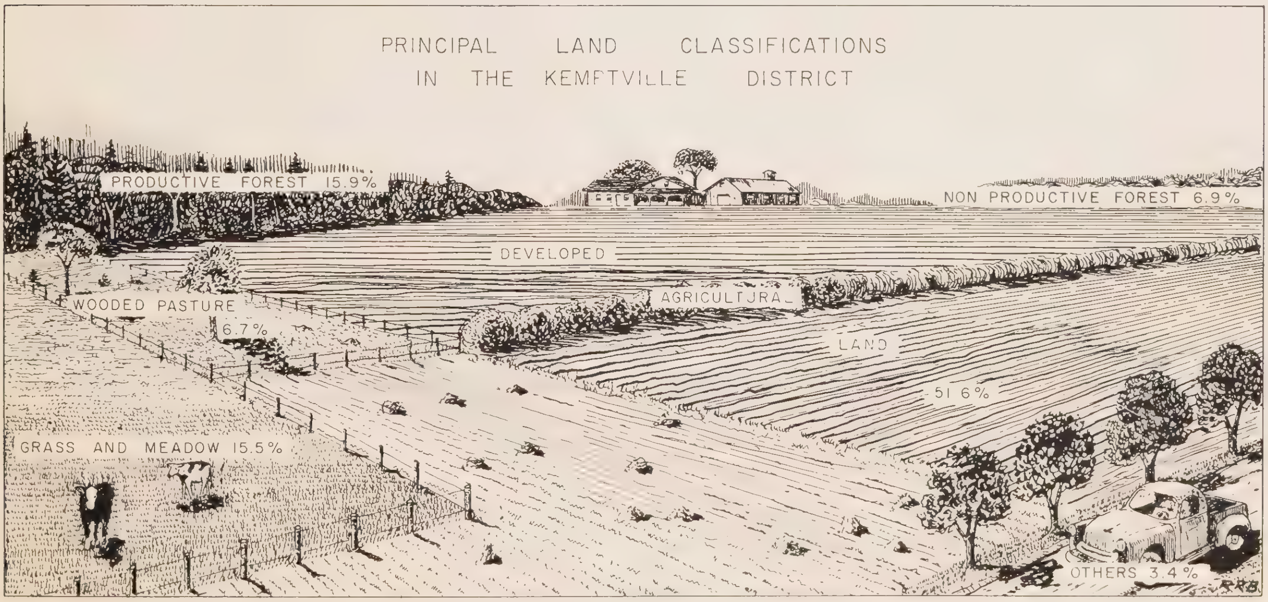
4. The age-class distribution for the productive forest lands of the district shows: 13 per cent mature, 56 per cent immature, 14 per cent all-aged, 16 per cent young growth and one per cent reproducing forest.

5. For the district as a whole the hardwood type predominates, occupying 60 per cent of the productive forest area; the mixedwoods type occupies 28 per cent and the coniferous only 12 per cent.

6. The volume of the primary growing stock in the Kemptville district is 686.9 million cubic feet. This is an average of 1,329 cubic feet per acre. Hardwoods predominate, making up 77 per cent of the total volume.

7. The annual allowable cut, or total depletion allowable under sustained yield management for the Kemptville district, is 18 million cubic feet, of which 99 per cent is on patented lands. The allowable cut on patented lands is made up of 18 per cent coniferous species and 82 per cent hardwood species.

8. The actual utilization of timber on patented lands is almost 37 million cubic feet. Nearly 30 million cubic feet is utilized for fuelwood and the remainder for logs, pulpwood, posts and poles. A comparison of this figure with the allowable cut on patented lands indicates that these are being overcut by some 19 million cubic feet annually.



MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Village of Kemptville, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Historical Background

• By the early years of the nineteenth century, settlement had extended westward beyond the rapids on the Ottawa and St. Lawrence Rivers. As late as 1861, however, Eastern Ontario could be described as an area of unbroken forest and impassable swamps. Settlement, stimulated in part by the lumber industry, proceeded rapidly along the river valleys, and soon the desire for land and timber led to the penetration of the area between the two rivers by both farmers and loggers.

From the earliest days of settlement oak and pine were reserved for the Royal Navy, and only contractors holding licenses from them could cut timber on public lands. This was altered in Upper Canada in 1826 so that anyone could cut timber on the ungranted lands of the Ottawa lumber region on payment of a fixed scale of rates to the Crown.

The first operations were confined to the removal of only the choicest and largest pine for square timber. The benefits of this method were largely nullified by the fires which resulted from the carelessness of the operators. Lumbermen later extracted the smaller pine to produce "waney timber" and "deals" for Britain, and eventually lumber for the American market. Oak, elm and ash found a ready market in Quebec.

Settlers cleared and burned the maple and beech, collecting the ashes for sale to potash manufacturers. At a later date, a fuelwood market developed in Montreal for these species. The appearance of first the steamship and then the train made large new demands upon the fuelwood species of the forest.

Joint action by the settlers and lumbermen rapidly removed the tree growth from the rich agricultural lands. Despite much waste by fire and poor utilization, such action may have been beneficial to the Province, in that it provided the areas of farm land necessary to permanent settlement. In addition, the lumbering operations provided a ready market for the harvest of these early settlers, as well as winter employment for the farmer. Unfortunately, this method of clearing land was extended to areas that should have remained permanently devoted to forestry; and the reclamation of these areas, burned over after lumbering and unsuited to agriculture, remains a problem to the present day.

Areas

The total area of the Kemptville district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 3,329,488 acres (table 1), 5,202 square miles. This area is surveyed into 61 townships, which comprise 8 counties and part of one other. Within the district, inland waters, excluding Lake Ontario and the Ottawa and St. Lawrence Rivers, cover an area of 95,256 acres, or 3 per cent of the total area, leaving a net land area of 3,234,232 acres. Productive forest lands occupy 516,880 acres, or 15 per cent of the total area (fig. 1).

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	13,192	503,688	516,880
Non-forested land[2]			
Developed agricultural land	462	1,670,784	1,671,246
Grass and meadow land	6,860	494,868	501,728
Non-reproducing burn		294	294
Wooded pasture	770	217,206	217,976
Unclassified land[3]	4	101,926	101,930
TOTAL	8,096	2,485,078	2,493,174
Non-productive forest[4]			
Open muskeg	568	32,222	32,790
Treed muskeg (scrub)	238	8,558	8,796
Brush, alder and flooded land	14,518	161,074	175,592
Rock outcrop	24	6,976	7,000
TOTAL	15,348	208,830	224,178
Water	95,256		95,256
TOTAL AREA	131,892	3,197,596	3,329,488

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

[2] Productive forest lands permanently withdrawn from timber production use.

[3] Lands occupied by roads, railroads, towns, etc.

[4] Lands which appear to be permanently out of commercial timber producing class, owing to very low productivity.

Non-productive forest lands, which appear to be permanently unfit for commercial timber production due to very low productivity, comprise 224,178

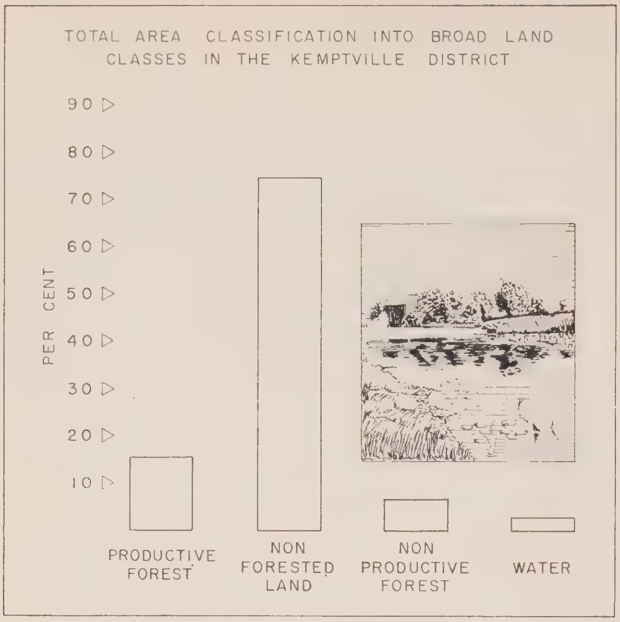


FIGURE 1

acres, slightly under 7 per cent of the total area. Non-forested lands, which include areas permanently withdrawn from timber production, total 2,493,174 acres, or about 75 per cent of the total area. This classification includes 1,671,246 acres of developed agricultural land and 501,728 acres of grass and meadow (fig. 2). Within this category are 217,976 acres of wooded pasture. These are areas containing low density stands (often comprised of a few large open-grown trees with wide spreading crowns) that are usually quite heavily grazed. Also included in this classification are 294 acres of non-reproducing burn and 101,930 acres of unclassified land occupied by cities, towns, villages, roads, railways, power lines, gravel-pits or otherwise withdrawn from forest production.

The Kemptville district is essentially an agricultural area largely devoted to dairying. Farming within this region is still undergoing a period of adjustment, during which the farms are decreasing in number and increasing in size. This district contains a large number of cheese factories to which

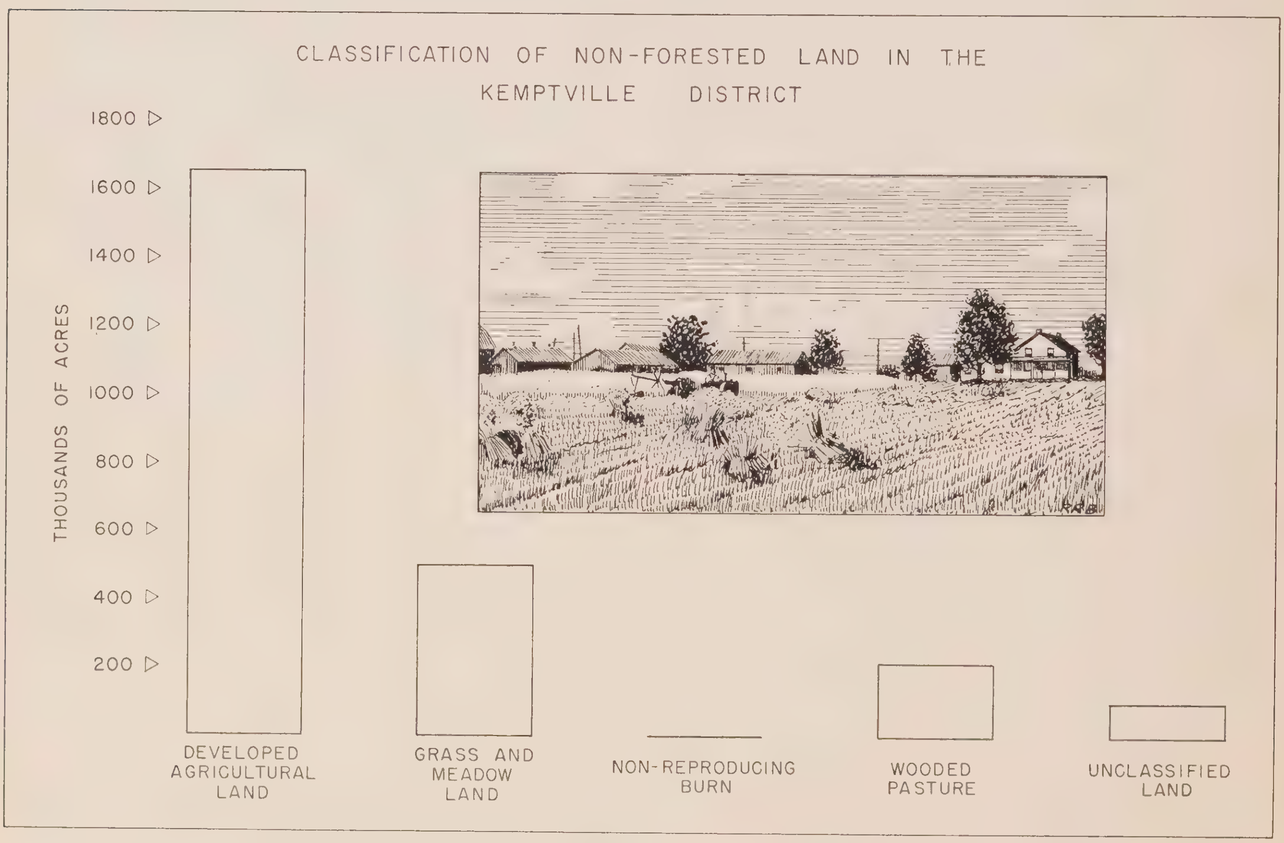


FIGURE 2

the dairy farms deliver their produce. The bulk of the forest area is composed of farm woodlots from which the farmers obtain fuelwood, lumber and posts. In some localities they provide a valuable cash crop through the production of maple syrup and maple sugar.

Table 2 shows the distribution of the principal land classifications by townships and counties. Productive forest land ranges from just over 8 per cent of the total land area in Dundas County to slightly over 31 per cent in Lanark County. In the other counties within this district, productive forest land forms from 10 to 16 per cent of the total land area. The distribution of productive forest land by townships is illustrated graphically in figure 3. Within the nine counties non-productive forest comprises from 5 to 10 per cent of the total land area.

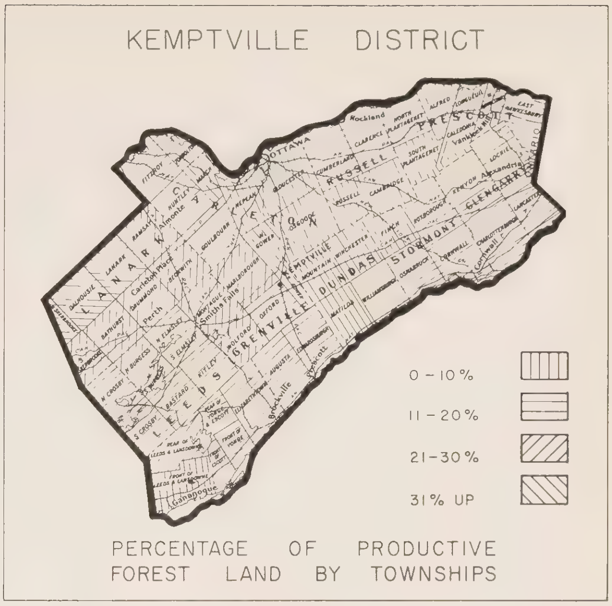


FIGURE 3

Dundas County, with 71 per cent of the land area classified as developed agricultural land, 9 per cent as grass or meadow, and 2 per cent as wooded pasture, has 82 per cent of its total land area devoted to agriculture. It is followed by Prescott with 80 per cent, Russell and Glengarry with 77 per cent each. In these counties developed agricultural land predominates, forming 66 per cent of the total area in Prescott, 63 per cent in Russell and 55 per cent in Glengarry. Carleton County has 53 per cent developed agricultural land, 15 per cent grass and meadow and 7 per cent wooded pasture. Stormont County has these classifications altered to 55, 18 and 3 per cent. In the remaining three counties developed agricultural land is reduced below 50 per cent of the total land area, being 48 per cent in Grenville, 40 per cent in Leeds, and 38 per cent in Lanark. Grass and meadow land and wooded pasture show a corresponding increase; the respective figures being 17 and 7 per cent for Grenville, 22 and 14 for Leeds, and 15 and 8 per cent for Lanark.

Land suitable for reforestation.

TABLE 2. — *Principal land classifications by townships and counties — Kemptville district.*

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas [1]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Fitzroy	64,744	62,950	8,490	13.5	356	0.6	36,470	57.9	9,116	14.5	6,778	10.7	1,740	2.8
Gloucester	85,962	85,362	5,908	6.9	7,942	9.3	49,048	57.5	7,726	9.1	2,248	2.6	12,490	14.6
Goulbourn	65,838	65,686	9,080	13.8	4,548	6.9	33,382	50.8	12,248	18.7	4,894	7.5	1,534	2.3
Huntley	62,790	62,768	10,596	16.9	3,164	5.0	24,352	38.8	13,916	22.2	9,098	14.5	1,642	2.6
March	28,220	27,866	2,686	9.6	1,212	4.4	10,142	36.4	8,294	29.8	3,098	11.1	2,434	8.7
Marlborough	61,876	61,314	15,764	25.7	6,940	11.3	18,334	29.9	10,604	17.3	8,690	14.2	982	1.6
Nepean	65,200	64,220	2,838	4.4	998	1.6	36,534	56.9	8,364	13.0	1,660	2.6	13,826	21.5
North Gower	34,194	33,342	1,628	4.9	2,162	6.5	25,356	76.1	2,380	7.1	908	2.7	908	2.7
Osgoode	88,106	87,742	6,338	7.2	5,476	6.2	60,258	68.7	11,188	12.8	2,260	2.6	2,222	2.5
Torbolton	27,340	27,328	5,264	19.3	1,250	4.6	11,760	43.0	4,998	18.3	3,044	11.1	1,012	3.7
CARLETON COUNTY	584,270	578,578	68,592	11.8	34,048	5.9	305,636	52.8	88,834	15.3	42,678	7.4	38,790	6.8
Matilda	62,388	62,372	4,778	7.7	3,370	5.4	44,584	71.5	6,528	10.4	1,576	2.5	1,536	2.5
Mountain	57,600	57,558	2,180	3.8	5,826	10.1	41,464	72.0	6,084	10.6	582	1.0	1,422	2.5
Williamsburgh	60,754	60,754	11,582	19.1	4,892	8.0	35,188	57.9	5,532	9.1	1,930	3.2	1,630	2.7
Winchester	57,982	57,864	1,564	2.7	2,652	4.6	48,452	83.7	2,896	5.0	508	0.9	1,792	3.1
DUNDAS COUNTY	238,724	238,548	20,104	8.4	16,740	7.0	169,688	71.2	21,040	8.8	4,596	1.9	6,380	2.7
Charlottenburgh	81,532	81,296	14,380	17.7	4,572	5.6	38,296	47.1	16,932	20.8	4,806	5.9	2,310	2.9
Kenyon	78,348	77,268	14,702	19.0	6,202	8.0	31,188	40.4	19,244	24.9	4,178	5.4	1,754	2.3
Lancaster	57,242	57,106	7,196	12.6	1,742	3.0	39,722	69.6	5,538	9.7	1,408	2.5	1,500	2.6
Locheil	71,744	71,586	8,496	11.9	1,914	2.7	47,772	66.7	9,822	13.7	1,844	2.6	1,738	2.4
GLENGARRY COUNTY	288,866	287,256	44,774	15.6	14,430	5.0	156,978	54.7	51,536	17.9	12,236	4.3	7,302	2.5
Augusta	74,778	74,756	11,266	15.1	6,424	8.6	33,780	45.2	15,862	21.2	5,112	6.8	2,312	3.1
Edwardsburgh	72,756	72,656	13,364	18.4	5,620	7.7	35,026	48.2	11,082	15.2	5,488	7.6	2,076	2.9
Oxford	62,756	61,908	8,058	13.0	5,768	9.3	34,742	56.1	7,490	12.1	3,820	6.2	2,030	3.3
South Gower	21,348	20,918	2,018	9.6	2,926	14.0	13,326	63.7	1,246	6.0	822	3.9	580	2.8
Wolford	53,308	51,150	10,722	21.0	7,034	13.7	17,636	34.5	11,312	22.1	3,490	6.8	956	1.9
GRENVILLE COUNTY	284,946	281,388	45,428	16.1	27,772	9.9	134,510	47.8	46,992	16.7	18,732	6.7	7,954	2.8
Bathurst	64,376	61,706	16,688	27.0	2,036	3.3	32,080	52.0	6,396	10.4	3,280	5.3	1,226	2.0
Beckwith	61,658	58,358	16,460	28.2	3,578	6.2	18,840	32.3	12,604	21.6	5,222	8.9	1,654	2.8
Dalhousie	65,516	62,188	37,976	61.1	1,874	3.0	19,688	31.6	2,050	3.3	....	....	600	1.0
Drummond	63,614	59,736	15,698	26.3	4,044	6.8	30,274	50.7	5,378	9.0	2,706	4.5	1,636	2.7
Lanark	65,290	62,592	25,590	40.9	1,566	2.5	33,094	52.9	1,072	1.7	106	0.2	1,164	1.8
Montague	70,174	68,736	15,180	22.1	4,474	6.5	19,714	28.7	18,606	27.1	8,694	12.6	2,068	3.0
North Burgess	42,008	36,616	8,024	21.9	2,954	8.1	6,208	17.0	10,190	27.8	8,838	24.1	402	1.1
North Elmsley	35,518	32,116	5,362	16.7	2,788	8.7	13,188	41.1	6,936	21.6	2,864	8.9	978	3.0
North Sherbrooke	16,506	15,826	8,816	55.7	328	2.1	5,754	36.3	618	3.9	126	0.8	184	1.2
Ramsay	63,860	62,598	13,960	22.3	888	1.4	31,472	50.3	9,016	14.4	5,488	8.8	1,774	2.8
South Sherbrooke	41,484	37,632	11,318	30.1	5,218	13.9	4,592	12.2	9,222	24.5	6,738	17.9	544	1.4
LANARK COUNTY [2]	590,004	558,104	175,072	31.4	29,748	5.3	214,904	38.5	82,088	14.7	44,062	7.9	12,230	2.2
Bastard	60,036	55,084	8,480	15.4	1,430	2.6	23,122	42.0	13,994	25.4	6,844	12.4	1,214	2.2
Elizabethtown	83,600	82,576	13,050	15.8	5,962	7.2	39,454	47.8	14,858	18.0	5,852	7.1	3,400	4.1
Front of Escott	25,156	25,124	3,892	15.5	758	3.0	9,016	35.9	4,680	18.6	6,242	24.9	536	2.1
Front of Leeds and Lansdowne	67,634	66,416	3,870	5.8	6,660	10.0	35,188	53.0	12,130	18.3	6,462	9.7	2,106	3.2
Front of Yonge	30,800	29,916	4,624	15.4	1,310	4.4	11,446	38.3	6,136	20.5	5,774	19.3	626	2.1
Kitley	55,338	54,756	8,888	16.2	2,870	5.2	23,242	42.5	15,280	27.9	3,486	6.4	990	1.8
North Crosby	51,544	45,220	7,602	16.8	3,902	8.6	10,822	24.0	11,802	26.1	10,308	22.8	784	1.7
Rear of Leeds and Lansdowne	60,226	50,608	12,044	23.8	1,802	3.6	19,098	37.7	8,964	17.7	7,884	15.6	816	1.6
Rear of Yonge and Escott	33,322	30,242	5,378	17.8	2,144	7.1	11,928	39.4	6,142	20.3	4,036	13.4	614	2.0
South Burgess	13,952	8,014	2,398	29.9	286	3.6	1,854	23.1	1,928	24.1	1,380	17.2	168	2.1
South Crosby	52,982	41,130	7,192	17.5	4,200	10.2	11,564	28.1	8,110	19.7	9,160	22.3	904	2.2
South Elmsley	29,410	25,140	4,206	16.7	1,404	5.6	9,194	36.6	6,682	26.6	2,684	10.7	970	3.8
LEEDS COUNTY	564,000	514,226	81,624	15.9	32,728	6.4	205,928	40.0	110,706	21.5	70,112	13.6	13,128	2.6
Alfred	41,962	41,760	2,392	5.7	4,134	9.9	29,358	70.3	3,888	9.3	1,042	2.5	946	2.3
Caledonia	43,902	43,902	2,420	5.5	8,586	19.6	28,788	65.6	2,994	6.8	320	0.7	794	1.8
East Hawkesbury	55,294	55,134	7,482	13.6	814	1.5	38,958	70.6	5,114	9.3	1,304	2.4	1,462	2.6
Longueuil	19,534	19,534	1,362	7.0	244	1.3	14,364	73.5	2,198	11.2	934	4.8	432	2.2
North Plantagenet	48,568	47,944	7,278	15.2	4,178	8.7	26,650	55.6	6,122	12.8	2,120	4.4	1,596	3.3
South Plantagenet	47,988	47,548	3,024	6.4	2,246	4.7	35,114	73.9	4,610	9.7	1,392	2.9	1,162	2.4
West Hawkesbury	29,988	29,962	5,084	17.0	1,096	3.7	16,346	54.6	4,444	14.8	1,524	5.0	1,468	4.9
PRESCOTT COUNTY	287,236	285,784	29,042	10.2	21,298	7.4	189,578	66.3	29,370	10.3	8,636	3.0	7,860	2.8
Cambridge	61,622	61,062	4,080	6.7	9,948	16.3	35,228	57.7	8,118	13.3	2,368	3.9	1,320	2.1
Clarence	70,072	70,006	10,724	15.3	7,258	10.4	37,030	52.9	9,318	13.3	3,478	5.0	2,198	3.1
Cumberland	74,580	74,580	7,926	10.6	6,900	9.3	47,792	64.1	7,632	10.2	2,456	3.3	1,874	2.5
Russell	46,416	46,290	1,872	4.0	2,072	4.5	38,728	83.7	1,908	4.1	394	0.9	1,316	2.8
RUSSELL COUNTY	252,690	251,938	24,602	9.8	26,178	10.4	158,778	63.0	26,976	10.7	8,696	3.4	6,708	2.7
Cornwall	63,874	63,792	8,134	12.8	5,710	9.0	25,394	39.8	18,152	28.4	2,882	4.5	3,520	5.5
Finch	50,382	50,130	2,012	4.0	1,128	2.2	38,218	76.2	6,458	12.9	882	1.8	1,432	2.9
Osnabruck	59,810	59,802	8,478	14.2	5,926	9.9	35,324	59.1	6,374	10.6	2,080	3.5	1,620	2.7
Roxborough	71,394	71,394	9,018	12.6	8,472	11.9	36,310	50.9	13,202	18.5	2,384	3.3	2,008	2.8
STORMONT COUNTY	245,460	245,118	27,642	11.3	21,236	8.6	135,246	55.2	44,186	18.0	8,228	3.4	8,580	3.5
TOTAL KEMPTVILLE DISTRICT	3,336,196 [3]	3,240,940 [3]	516,880	15.9	224,178	6.9	1,671,246	51.6	501,728	15.5	217,976	6.7	108,932 [3]	3.4

[1] Other areas include all land administered by the Federal Government, and roads, railroads, villages, towns, cities, gravel-pits, etc.

[2] Lanark County includes only those townships within the Kemptville district.

[3] These totals include land areas administered by the Federal Government.

Forest Land Ownership

In Ontario, forest lands have generally been retained under public ownership, and the right to cut and remove timber from them has been granted by a licence. Lands suitable for agriculture have been opened for settlement, and lands have been granted or sold under the various land settlement regulations which have been in force from time to time. Lands are also patented for mining purposes, summer resorts and other uses. All of these various types of ownership are grouped under "patented lands," which include all lands owned privately, in contrast to Crown lands.

The Kemptville district comprises one of the oldest settled parts of Ontario, and much of this settlement occurred under regulations embodied in the Crown Timber Act of 1849, with subsequent amendments[1]. At that time Ontario was regarded as a purely agricultural area in which timber was not considered a profitable crop. The purpose of the legislators was to clear the ground for general farming purposes and, in so doing, to dispose of the most valuable timber to the best advantage. Under this system the land was rapidly settled, but much land was cleared and settled that would have been better left in forest.

Of the total area of the Kemptville district, 3,197,596 acres, or 96 per cent, is patented land and 131,892 acres, or 4 per cent, is owned by the Crown (table 1).

Considering only the productive forest land totalling 516,880 acres, 503,688 acres, or 97 per cent, is patented land, and 13,192 acres, or 3 per cent, is in Crown ownership (fig. 4).

Under the terms of legislation of what is now known as The Tree Act (R.S.O. 1950), any municipality may purchase land and either place the responsibility of reforestation and management in the hands of the Provincial Government through co-operative agreements, or carry out the planting and management of the forest without an agreement. Areas for which an agreement has been signed with the Minister of Lands and Forests are, for the purposes of this report, included with Crown lands.

The agreement provides that the Provincial Government will assume the responsibility for re-establishment and care of the forest for a stated period of years (usually fifty in recent agreements). At the

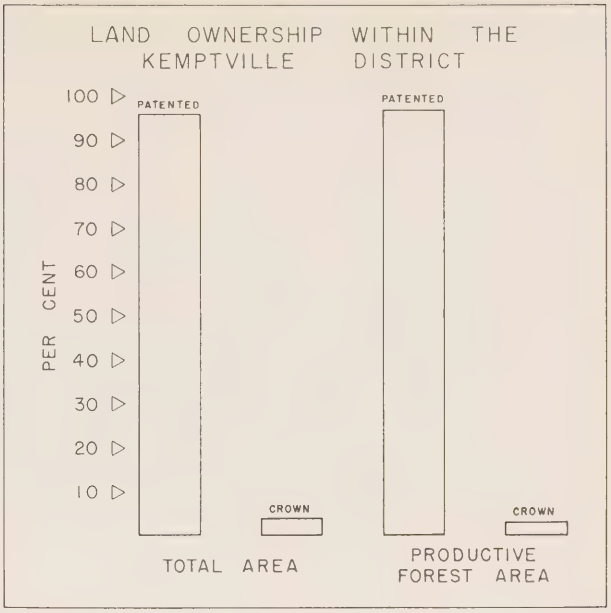


FIGURE 4

end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price.

There are no River Valley Authority Forests within the Kemptville district, but there are both County and Township Forests under agreement with the Crown.

The Larose Forest was established by the counties of Prescott and Russell in 1928 with 1,200 acres. It has been increased by regular land acquisition ever since and now contains 23,386 acres. In 1940, Leeds and Grenville Counties established the Limerick Forest of 2,000 acres. This has since been increased to an area of 5,235 acres. Stormont, Dundas and Glengarry have a County Forest of slightly more than 1,500 acres; and about 100 acres of the Lanark County Forest occur within the Kemptville district.

The townships of Cumberland, Marlborough and Torbolton have Township Forests totalling 1,439 acres. These are named after the respective township and range in size from 200 to 800 acres.

The Kemptville Forest Station is a Crown area of 1,800 acres which includes a forest nursery established in 1946.

[1] Forestry, Ontario, 1899. Annual Report of the Clerk of Forestry for the Province of Ontario, 1899.

Age Classes

In order to produce sustained timber yields, a forest should be made up of trees of all age classes[1] and stages of development from seedlings to mature timber, in such proportions that when one group of trees is harvested another is ready to take its place. The forests of the Kemptville district do not meet this requirement.

Of the total productive forest area, 65,516 acres, or 13 per cent, is mature; 291,862 acres, or 56 per cent, is immature; 70,675 acres, or 14 per cent, is classed as all-aged; 80,952 acres, or 16 per cent, is young growth; and 7,875 acres, or one per cent, is reproducing forest (table 3, fig. 5).

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	....	1,202	1,202	*
Hardwood	188	58,618	58,806	12
Mixedwoods	102	5,406	5,508	1
TOTAL	290	65,226	65,516	13
Immature forest:				
Coniferous	432	43,422	43,854	8
Hardwood	4,110	140,938	145,048	28
Mixedwoods	1,574	101,386	102,960	20
TOTAL	6,116	285,746	291,862	56
All-aged forest:				
Hardwood	78	48,294	48,372	10
Mixedwoods	45	22,258	22,303	4
TOTAL	123	70,552	70,675	14
Young growth:				
Coniferous	210	9,990	10,200	2
Hardwood	1,624	53,430	55,054	11
Mixedwoods	94	15,604	15,698	3
TOTAL	1,928	79,024	80,952	16
Reproducing forest	4,735	3,140	7,875	1
TOTAL PRODUCTIVE FOREST	13,192	503,688	516,880	100

* Less than one per cent.

[1] Range of ages is shown in Appendix, age classes, page 28.

While patented land, totalling 503,688 acres, shows a similar distribution to the total productive forest area, the distribution on Crown land is quite different. The mature area occupies 290 acres, or 2 per cent of the productive forest area; the immature, 6,116 acres, or 46 per cent; the all-aged, 123 acres, or one per cent. Young growth covers 15 per cent of the area and reproducing forest, 36 per cent.

Regional Forest Types

The Kemptville district lies wholly within the Great Lakes–St. Lawrence Forest Region. Local climatic conditions, together with soil and rock formations, have combined to produce a broad uniformity of tree species associations. Sugar maple and yellow birch may be considered the indicating species, while red maple and white pine are widespread throughout most of the area. Hemlock and beech are present in much of the region. Lumbering and settlement have so modified the forests of this district that very few, if any, of the original stands remain, and the remaining forests are largely confined to the poorer sites.

Separate volume and yield tables are prepared for each region, or section, and they serve as units in the compilation of volume estimates. In the Kemptville district two forest sections are represented (fig. 6) as follows:

1. The Algonquin section, which occupies a narrow strip along the western boundary of the district, forms 20 per cent of the total area.

2. The St. Lawrence section, in the eastern part of the district, covers 80 per cent of the total area.

The Algonquin section differs fundamentally from the remainder of the Great Lakes–St. Lawrence forest in that the bedrock is part of the Precambrian Shield, and consists largely of crystalline limestone, schists and gneisses of the altered sedimentaries and granite intrusives. These rocks are exposed in the Frontenac Axis, an arm of the Shield which extends southward through the Rideau Lake country to Brockville. The topography is rough and irregular. Generally, the area is one of a mixed forest with an association in which sugar maple, yellow birch, hemlock and white pine predominate. The former extensive pine areas are largely occupied by a secondary association of aspen, white birch, balsam fir, white spruce, white and red pine, soft maple, red oak and ironwood.

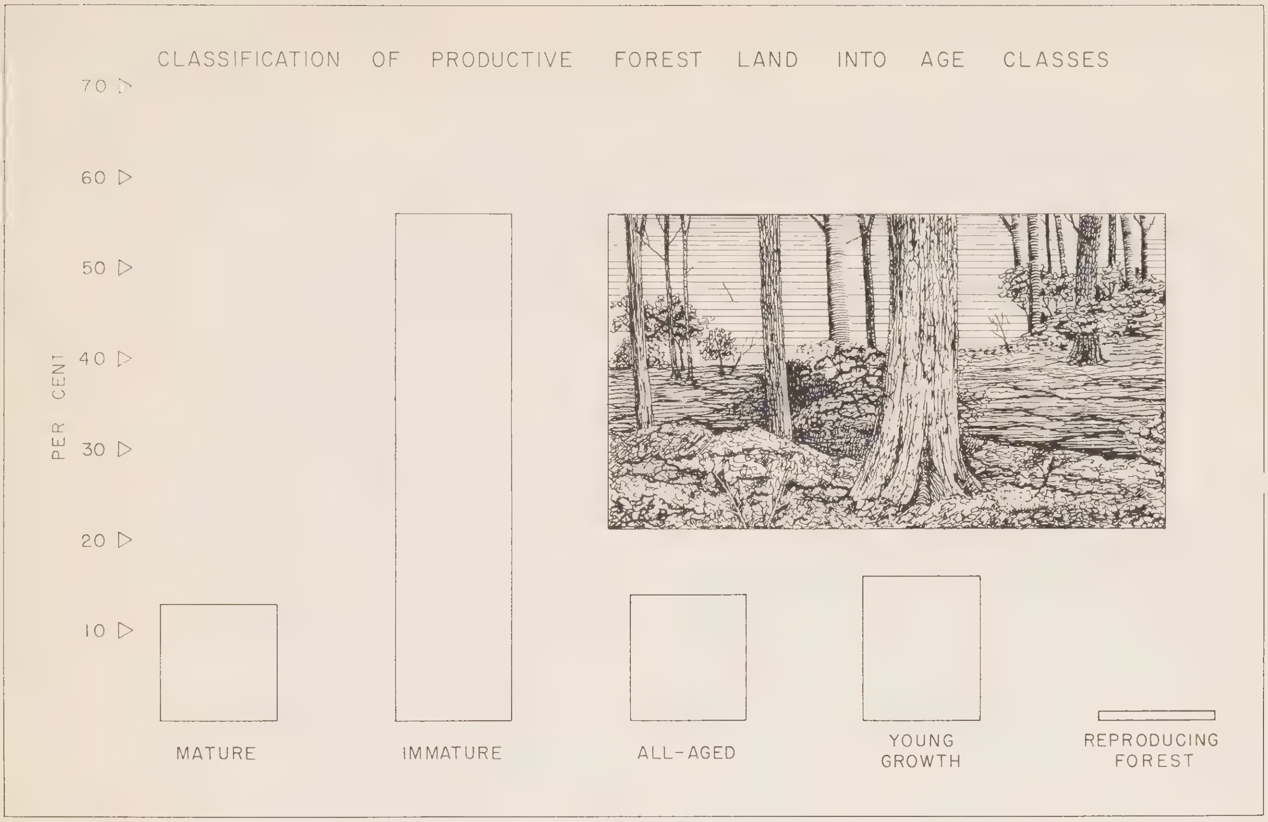


FIGURE 5

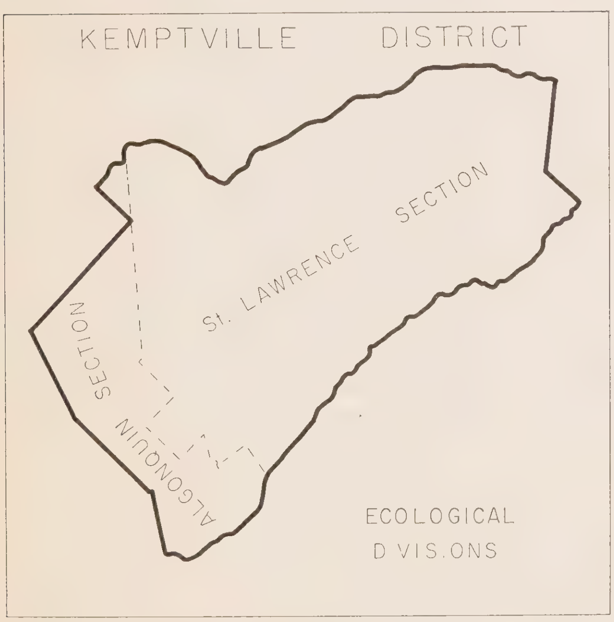


FIGURE 6

The St. Lawrence section consists of the lowlands between the St. Lawrence and Ottawa Rivers. Sand, clay and lime were deposited over the hard rocks of the Shield during the Palaeozoic Era. These became the sandstones, shales, limestones and dolomite which now constitute the bedrock of this region. These bedrocks have remained nearly level, owing to the resistance of the Shield to earth movements, although some faults have resulted from tilting, cracking and displacement. The tough limestone has resisted weathering and erosion, and this, with the flatness of the plain, has impeded adequate drainage.

This lowland area, of flat-lying Ordovician and local Cambrian limestones, is covered with glacial material overlain by extensive deposits of marine clays and sands. Broad-leaved associations containing a fair representation of coniferous growth are characteristic. Sugar maple and beech, with yellow birch, white elm, red maple, basswood, ash, oak and aspen, are the dominant association. Poorly-drained depressions support larch, white

cedar, black spruce and black ash. Second-growth stands of aspen and white birch, with balsam fir and white spruce, are found. Lying mainly within this section, and excluding the exposed portion of the Shield, are nine local land forms, or minor physiographic regions[1] (fig. 7):

1. *Leeds Knobs and Flats.* — These occur in the south-western corner of Leeds County, immediately north of the "Thousand Islands." The channels between the relatively bare rock-knobs are filled with a grey to drab clay that is weakly calcareous and amongst the best agricultural soils in Eastern Ontario.

2. *Smith's Falls Limestone Plain.* — This is the largest unbroken tract of shallow soil over limestone in southern Ontario. The area is generally level, with impeded drainage, and abounds in bogs. Soils vary greatly in texture, and stoniness is common. A few scattered areas of deep agricultural soils occur.

3. *Edwardsburg Sand Plain.* — The sand plain is a level or gently undulating area, with the occasional hummock or ridge. The parent sands have been leached, and the soils are acid and deficient in all important nutrients.

4. *North Gower Drumlin Field.* — Scattered drumlins, some incompletely formed, cover about 150 square miles. The drumlins have good drainage and adaptable soil but are limited by stoniness. The clay or silt lowlands lying between are poorly drained.

5. *Glengarry Till Plain.* — This is an area of low relief, undulating to rolling, which forms the drainage divide between the St. Lawrence and Ottawa Rivers. The characteristic feature is stoniness, and the fields are either dotted with rock piles or bordered by stone fences. The highly calcareous material has resisted weathering, and the soils are immature. The flat and gently sloping lands are poorly drained, and there are undrained depressions containing peat and muck.

6. *Winchester Clay Plain.* — This area forms one of the outstanding agricultural districts in Ontario. It is an area of low relief, and the plain is interrupted by a few low drumlins, areas of shallow soil, bars, beaches and boulder pavements. When adequate drainage is established, the soils are highly productive.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951

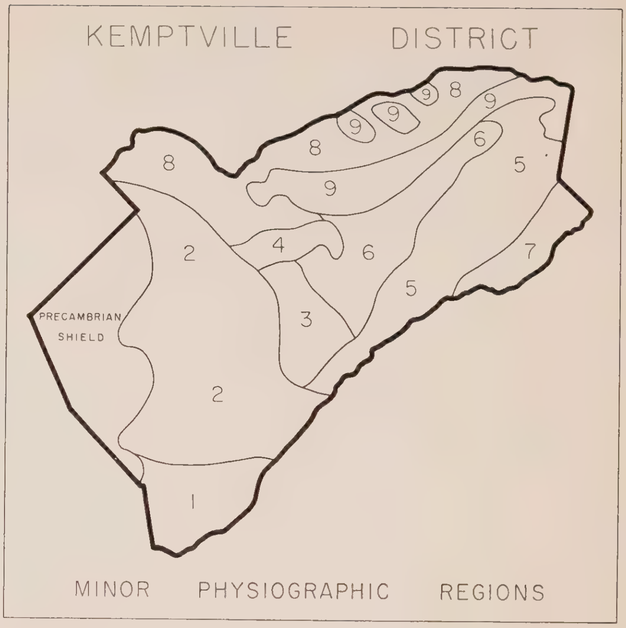


FIGURE 7

7. *Lancaster Flats.* — This area extends about eight miles back from the St. Lawrence River where water-laid deposits, ranging from clay to very fine sand, have buried the till plain. The land is flat and drainage is poor. It is the leading flax-producing area in Ontario.

8. *Ottawa Valley Clay Plains.* — The soil in this area is quite similar to the Winchester Clay Plain, but with a higher proportion of acid soil. Owing to the increasing market at Ottawa, agriculture in this region is becoming more specialized.

9. *Russell and Prescott Sand Plains.* — These consist of one large belt from Ottawa to Hawkesbury and three fairly large areas north of it in the townships of Alfred, Plantagenet and Clarence. Sand varies from coarse in the north to fine and silt in the south. These plains have a level surface approximately 250 feet above sea level, and are separated from the intervening clay valleys by abrupt bluffs which occasionally have intermediate terraces.

Cover Types

The forests of the Kemptville district contain 27 native tree species and three exotics, Norway spruce, European larch and Scots pine, which have been introduced in plantations within the district. Eight species comprise 78 per cent of the total wood volume: elm 20 per cent, sugar maple 16 per cent, soft maple 13 per cent, white cedar 9 per cent, poplar

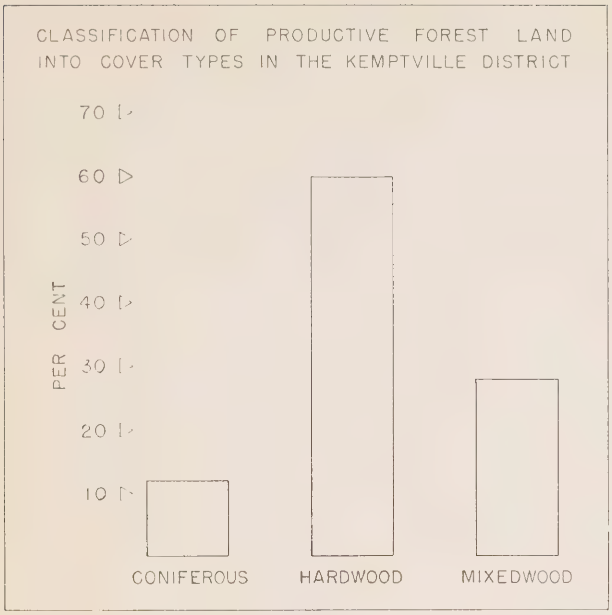


FIGURE 8

7 per cent, white pine 5 per cent, basswood 5 per cent and hemlock 3 per cent.

The forests of the district are described under three main cover types: coniferous, hardwood and mixedwoods. The coniferous type is one in which 75 per cent or more of the number of trees are conifers or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there are small areas of natural reproduction too recently established to have attained a sufficiently stable composition to be classified into cover types. The artificially established plantations are areas of reproduction which have been classified according to cover type.

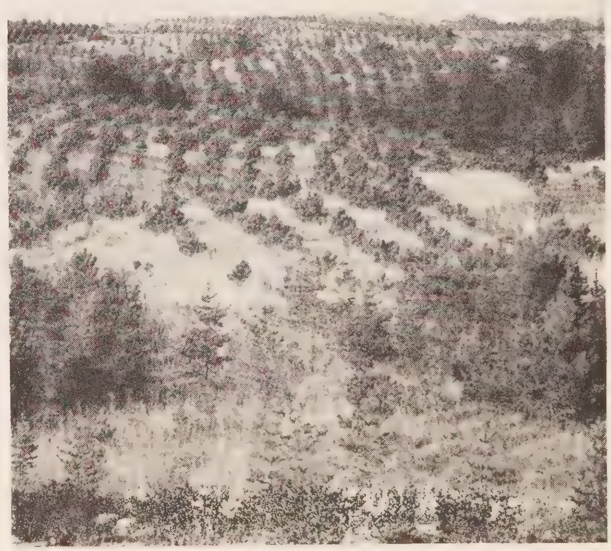
For the district as a whole the hardwood type predominates, occupying 60 per cent of the productive forest land (table 4); the mixedwoods type occupies 28 per cent and the coniferous type only 12 per cent (fig. 8).

The cover type distribution for patented land is almost identical, with the mixedwoods type increased one per cent to 29 per cent, and the coniferous type reduced to 11 per cent. Crown lands, which occupy only 3 per cent of the productive forest area, show: 49 per cent hardwood, 37 per cent coniferous and 14 per cent mixedwoods. In all categories, reproducing forest accounts for less than one per cent of the productive forest area.

TABLE 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	....	....	1,202	*	1,202	*
Immature	432	3	43,422	9	43,854	9
Young growth	210	2	9,990	2	10,200	2
Plantations	4,187	32	890	*	5,077	1
TOTAL	4,829	37	55,504	11	60,333	12
Hardwood type:						
Mature	188	2	58,618	12	58,806	12
Immature	4,110	31	140,938	28	145,048	28
All-aged	78	*	48,294	9	48,372	9
Young growth	1,624	12	53,430	11	55,054	11
Plantations	468	4	4	*	472	*
TOTAL	6,468	49	301,284	60	307,752	60
Mixedwoods type:						
Mature	102	1	5,406	1	5,508	1
Immature	1,574	12	101,386	20	102,960	20
All-aged	45	*	22,258	5	22,303	4
Young growth	94	1	15,604	3	15,698	3
Plantations	....	....	18	*	18	*
TOTAL	1,815	14	144,672	29	146,487	28
Reproducing forest	80	*	2,228	*	2,308	*
TOTAL PRODUCTIVE FOREST	13,192	100	503,688	100	516,880	100

* Less than one per cent.



A recently established pine plantation.

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average Total
	4″-9″ d.b.h.	10″ up d.b.h.	Average Total	4″-9″ d.b.h.	10″ up d.b.h.	Average Total	
	cu.ft.	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*	*cu.ft.*
Mature	469	1,909	2,378	387	1,928	2,315	2,315
Immature	845	654	1,499	817	602	1,419	1,420
All-aged	610	1,089	1,699	618	1,090	1,708	1,709
Productive forest	408	356	764	600	744	1,344	1,329

The volume of the primary growing stock on productive forest lands in the Kemptville district is just under 687 million cubic feet (686,911,100 cubic feet). This is an average of 1,329 cubic feet per acre (table 5). The mature age class contains 151.7 million cubic feet (table 6), or 2,315 cubic feet per acre, while the immature age class contains 414.5 million cubic feet, or 1,420 cubic feet per acre.

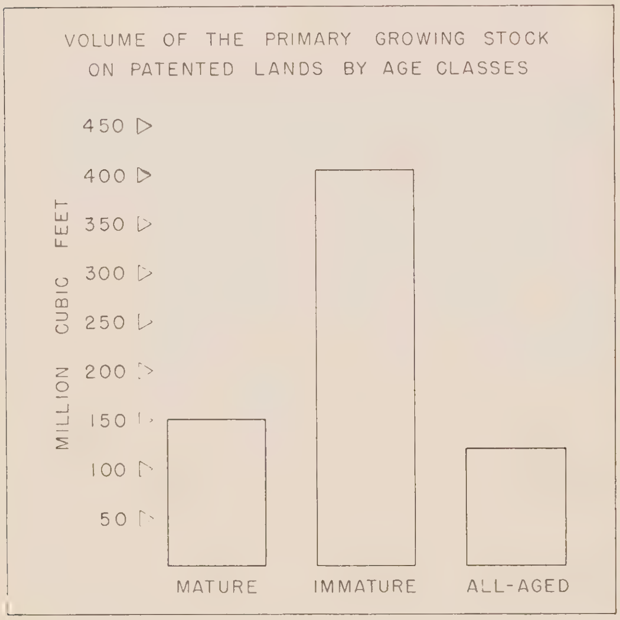
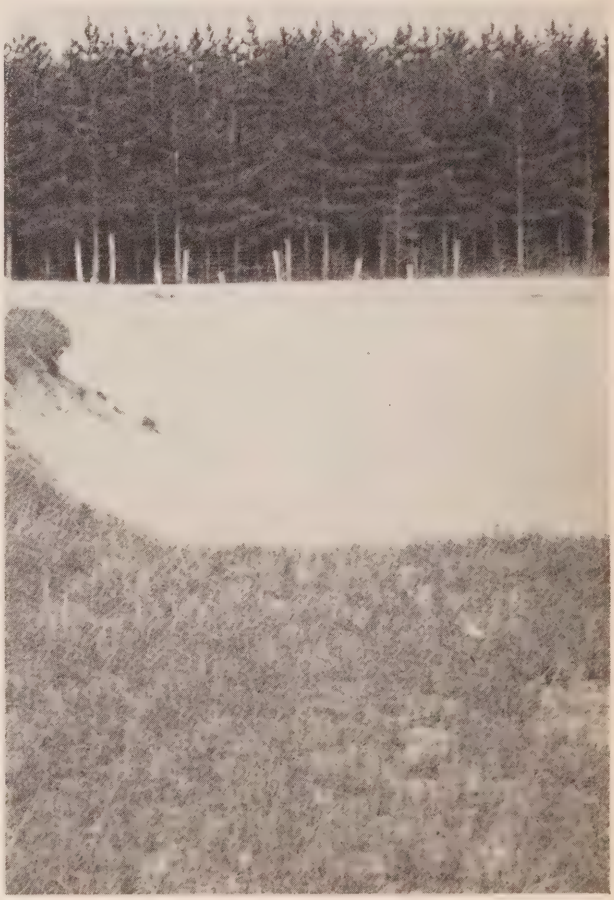


FIGURE 9

In addition, the all-aged stands contain 120.8 million cubic feet, or 1,709 cubic feet per acre of mature and immature timber.

Crown lands in the Kemptville district have a total volume of 10 million cubic feet (table 7), or an average of 764 cubic feet per acre. The mature age class contains 689 thousand cubic feet, or 2,378 cubic feet per acre; the immature, 9.1 million cubic feet, or 1,499 cubic feet per acre; and the all-aged stands, 209 thousand cubic feet, or 1,699 cubic feet per acre.

The volume of the primary growing stock on patented land in the Kemptville district is nearly 677 million cubic feet (table 8), or an average of 1,344 cubic feet per acre. The mature age class contains 151 million cubic feet, or 2,315 cubic feet per acre; the immature, 405.3 million cubic feet, or 1,419 cubic feet per acre; and the all-aged, 120.6 million cubic feet, or 1,708 cubic feet per acre (fig. 9).



Contrast in reforestation and erosion on two sides of a road.

Conifers vs. Hardwoods

The volume of the primary growing stock on productive forest lands in the Kemptville district is composed mainly of hardwoods or broadleaved species. The volume of hardwoods is nearly 529 million cubic feet, or 77 per cent of the growing stock, while conifers amount to about 158 million cubic feet, or 23 per cent of the primary growing stock (table 9).

The relatively small area of Crown land has the 10 million cubic feet distributed between hardwoods and conifers in the same proportion as for productive forest lands (table 10). The mature age class has 97 thousand cubic feet of conifers or 14 per cent of the mature volume; and 592 thousand cubic feet of hardwoods or 86 per cent of the mature volume. Immature stands of 9 million cubic feet contain 24 per cent coniferous volume and 76 per cent hardwood volume. The all-aged stands contain 209 thousand cubic feet, of which 15 per cent are conifers and 85 per cent hardwoods.

On patented lands, the volume of hardwoods is 521.1 million cubic feet, or 77 per cent of the total volume; while the volume of conifers is 155.7 million cubic feet, or 23 per cent of the total volume (table 11). The mature volume of 151.0 million cubic feet is composed of 93 per cent hardwoods and 7 per cent conifers. Immature stands contain 405.3 million cubic feet, composed of 68 per cent hardwoods and 32 per cent conifers. Stands classified as all-aged contain 120.5 million cubic feet. Hardwood species provide 86 per cent of this volume and conifers 14 per cent.

Of the 11 coniferous species recorded by the inventory, three (white cedar, white pine and hemlock) comprise 76 per cent of the coniferous volume within the district (fig. 10). The hardwood group, which contains 16 species, has 79 per cent of the volume produced by only five species. Elm accounts for 26 per cent, sugar maple 21 per cent, soft maple 16 per cent, poplar 9 per cent and basswood 7 per cent.

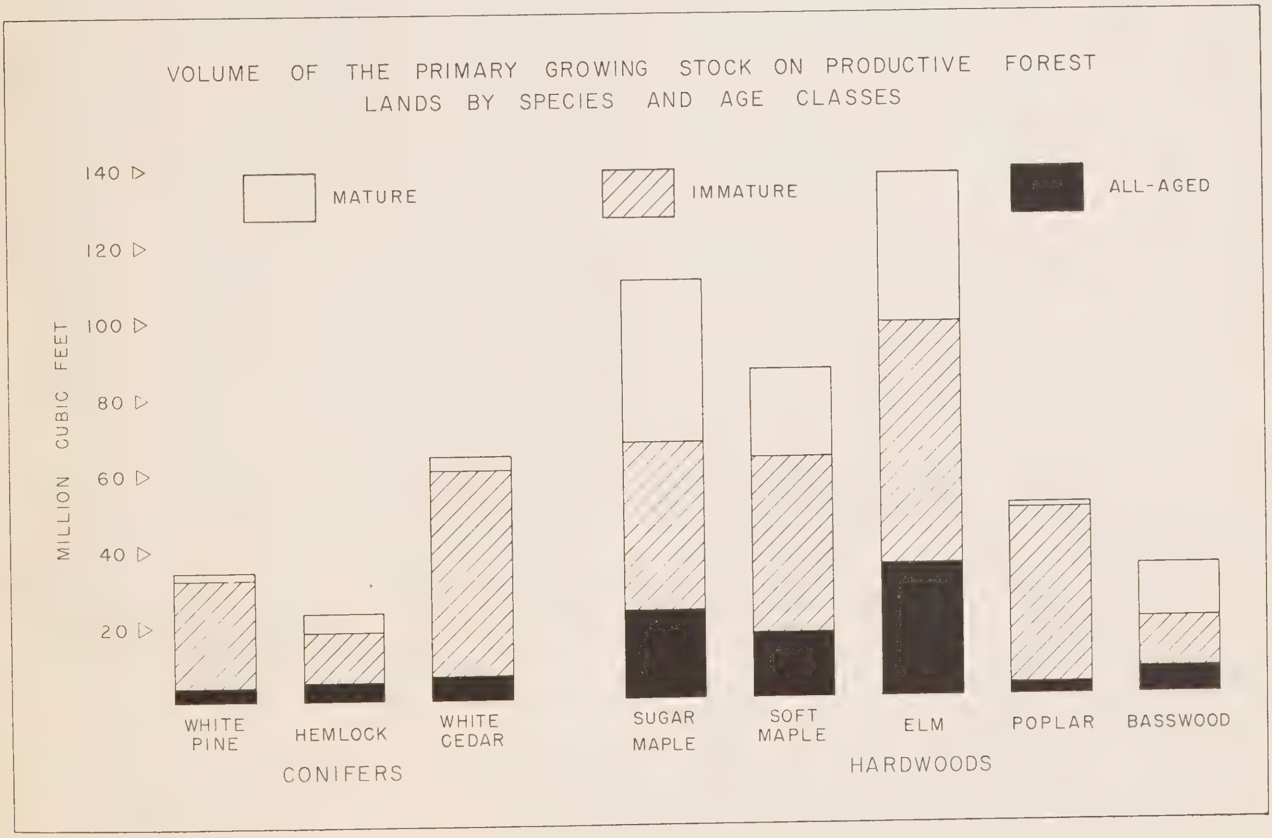


FIGURE 10

TABLE 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Kemptville district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	608	1,781	41,495	27,641	....	....	71,525
Hardwood......	22,237	114,556	111,476	77,345	29,214	53,809	408,637
Mixedwoods...	2,510	9,994	85,603	70,906	14,494	23,242	206,749
TOTAL........	25,355	126,331	238,574	175,892	43,708	77,051	686,911

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	539	1,301	35,628	20,928	....	....	58,396
Hardwood......	1,079	3,699	4,700	5,178	1,307	2,436	18,399
Mixedwoods...	1,102	3,226	35,908	28,079	5,860	7,012	81,187
TOTAL........	2,720	8,226	76,236	54,185	7,167	9,448	157,982

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	69	480	5,867	6,713	....	....	13,129
Hardwood......	21,158	110,857	106,776	72,167	27,907	51,373	390,238
Mixedwoods...	1,408	6,768	49,695	42,827	8,634	16,230	125,562
TOTAL........	22,635	118,105	162,338	121,707	36,541	67,603	528,929

TABLE 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Kemptville district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	....	....	476	333	....	....	809
Hardwood......	94	372	3,269	2,397	47	89	6,268
Mixedwoods...	42	181	1,425	1,273	28	45	2,994
TOTAL........	136	553	5,170	4,003	75	134	10,071

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	....	....	408	255	....	....	663
Hardwood......	4	20	146	177	2	4	353
Mixedwoods...	19	54	614	559	11	14	1,271
TOTAL........	23	74	1,168	991	13	18	2,287

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	....	....	68	78	....	....	146
Hardwood......	90	352	3,123	2,220	45	85	5,915
Mixedwoods...	23	127	811	714	17	31	1,723
TOTAL........	113	479	4,002	3,012	62	116	7,784

TABLE 8. — *Cubic-foot volumes of primary growing stock on patented land in the Kemptville district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature 4″-9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″-9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″-9″ d.b.h.	All-aged 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	608	1,781	41,019	27,308	....	....	70,716
Hardwood......	22,143	114,184	108,207	74,948	29,167	53,720	402,369
Mixedwoods...	2,468	9,813	84,178	69,633	14,466	23,197	203,755
TOTAL........	25,219	125,778	233,404	171,889	43,633	76,917	676,840

ALL CONIFERS

Cover type	Mature 4″-9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″-9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″-9″ d.b.h.	All-aged 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	539	1,301	35,220	20,673	....	....	57,733
Hardwood......	1,075	3,679	4,554	5,001	1,305	2,432	18,046
Mixedwoods...	1,083	3,172	35,294	27,520	5,849	6,998	79,916
TOTAL........	2,697	8,152	75,068	53,194	7,154	9,430	155,695

ALL HARDWOODS

Cover type	Mature 4″-9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″-9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″-9″ d.b.h.	All-aged 10″ up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous......	69	480	5,799	6,635	....	....	12,983
Hardwood......	21,068	110,505	103,653	69,947	27,862	51,288	384,323
Mixedwoods...	1,385	6,641	48,884	42,113	8,617	16,199	123,839
TOTAL......	22,522	117,626	158,336	118,695	36,479	67,487	521,145

TABLE 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Kemptville district by species and age class in two size classes.*

Species	Mature 4″-9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″-9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″-9″ d.b.h.	All-aged 10″ up d.b.h.	Total all lands
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	183	2,194	6,314	22,121	638	2,898	34,348
Red pine	1	....	656	1,431	....	....	2,088
Jack pine	17	4	56	....	....	....	77
Pitch pine	....	....	19	25	12	19	75
White spruce	80	427	4,835	6,767	260	724	13,093
Black spruce	9	13	1,961	369	2	....	2,354
Balsam fir	234	69	12,641	2,339	490	98	15,871
Hemlock	911	3,826	5,605	7,405	1,601	3,304	22,652
White cedar	1,276	1,688	41,226	13,147	3,960	2,324	63,621
Red cedar	....	....	3	....	6	1	10
Larch	9	5	2,920	581	198	80	3,793
TOTAL CONIFERS	2,720	8,226	76,236	54,185	7,167	9,448	157,982
Sugar maple	6,897	35,638	25,334	18,858	8,142	14,611	109,480
Soft maple	3,331	19,927	30,427	15,938	6,749	9,738	86,110
White birch	144	190	12,397	4,454	573	426	18,184
Yellow birch	1,187	2,634	6,134	6,030	1,850	1,768	19,603
Beech	1,074	5,734	2,504	3,610	657	1,785	15,364
Elm	5,060	34,164	31,770	31,567	10,094	24,557	137,212
Ironwood	874	147	3,699	256	1,190	90	6,256
Red oak	49	658	3,906	4,749	377	1,658	11,397
White oak	78	698	492	538	383	915	3,104
Poplar	212	599	23,852	22,152	893	2,377	50,085
Black ash	1,364	638	6,665	1,550	1,987	302	12,506
White ash	858	3,537	7,169	3,638	1,500	2,181	18,883
Basswood	1,090	12,559	5,541	7,360	1,523	6,119	34,192
Black cherry	57	107	912	263	86	107	1,532
Butternut	87	448	368	479	138	519	2,039
Hickory	273	427	1,168	265	399	450	2,982
TOTAL HARDWOODS	22,635	118,105	162,338	121,707	36,541	67,603	528,929
TOTAL ALL SPECIES	25,355	126,331	238,574	175,892	43,708	77,051	686,911

A Scots pine plantation.

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4–9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material, depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller size material in the top which may be used as pulpwood or for purposes other than saw timber. The total quantity of wood in this residual top is relatively small, and is included in the 10 inches and over material in all inventory estimates.

Patented lands contain nearly 99 per cent of the total wood volume in the Kemptville district. Considering all age classes on patented land, the 4 to 9-inch d.b.h. class contains 302.2 million cubic feet, or 45 per cent of the volume; and the 10-inch and over d.b.h. class contains 374.6 million cubic feet, or 55 per cent of the total volume (table 11).

TABLE 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Kemptville district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	1	12	118	430	2	7	570
Red pine	...	...	14	32	...	...	46
Jack pine	...	...	...	...	...	...	...
Pitch pine	...	...	...	...	1	...	1
White spruce	1	4	84	120	...	1	210
Black spruce	...	...	25	7	...	...	32
Balsam fir	3	1	270	53	...	...	327
Hemlock	8	44	94	148	4	7	305
White cedar	10	13	531	194	6	3	757
Red cedar	...	...	...	...	...	...	...
Larch	...	...	32	7	...	...	39
TOTAL CONIFERS	23	74	1,168	991	13	18	2,287
Sugar maple	46	205	795	629	14	25	1,714
Soft maple	9	36	641	310	11	16	1,023
White birch	2	2	307	111	1	11	424
Yellow birch	8	36	143	161	3	3	354
Beech	11	46	83	125	2	3	270
Elm	11	79	646	647	16	40	1,439
Ironwood	6	1	114	8	3	...	132
Red oak	1	6	124	141	1	3	276
White oak	...	1	6	8	1	3	19
Poplar	3	8	610	513	1	4	1,139
Black ash	6	4	140	43	3	1	197
White ash	3	9	180	89	3	4	288
Basswood	5	44	150	204	2	11	416
Black cherry	1	1	28	7	...	...	37
Butternut	...	1	8	10	...	1	20
Hickory	1	...	27	6	1	1	36
TOTAL HARDWOODS	113	479	4,002	3,012	62	116	7,784
TOTAL ALL SPECIES	136	553	5,170	4,003	75	134	10,071

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Kemptville district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	182	2,182	6,196	21,691	636	2,891	33,778
Red pine	1	...	642	1,399	...	...	2,042
Jack pine	17	4	56	...	...	...	77
Pitch pine	...	...	19	25	11	19	74
White spruce	79	423	4,751	6,647	260	723	12,883
Black spruce	9	13	1,936	362	2	...	2,322
Balsam fir	231	68	12,371	2,286	490	98	15,544
Hemlock	903	3,782	5,511	7,257	1,597	3,297	22,347
White cedar	1,266	1,675	40,695	12,953	3,954	2,321	62,864
Red cedar	...	...	3	...	6	1	10
Larch	9	5	2,888	574	198	80	3,754
TOTAL CONIFERS	2,697	8,152	75,068	53,194	7,154	9,430	155,695
Sugar maple	6,851	35,433	24,539	18,229	8,128	14,586	107,766
Soft maple	3,322	19,891	29,786	15,628	6,738	9,722	85,087
White birch	142	188	12,090	4,343	572	425	17,760
Yellow birch	1,179	2,598	5,991	5,869	1,847	1,765	19,249
Beech	1,063	5,688	2,421	3,485	655	1,782	15,094
Elm	5,049	34,085	31,124	30,920	10,078	24,517	135,773
Ironwood	868	146	3,585	248	1,187	90	6,124
Red oak	48	652	3,782	4,608	376	1,655	11,121
White oak	78	697	486	530	382	912	3,085
Poplar	209	591	23,242	21,639	892	2,373	48,946
Black ash	1,358	634	6,525	1,507	1,984	301	12,309
White ash	855	3,528	6,989	3,549	1,497	2,177	18,595
Basswood	1,085	12,515	5,391	7,156	1,521	6,108	33,776
Black cherry	56	106	884	256	86	107	1,495
Butternut	87	447	360	469	138	518	2,019
Hickory	272	427	1,141	259	398	449	2,946
TOTAL HARDWOODS	22,522	117,626	158,336	118,695	36,479	67,487	521,145
TOTAL ALL SPECIES	25,219	125,778	233,404	171,889	43,633	76,917	676,840

When the species groups are considered separately, 45 per cent of the coniferous volume and 58 per cent of the hardwood volume occur in the larger size class.

An examination of the species groups on patented lands by age classes discloses that, while conifers have 75 per cent of the mature volume in the larger size class, this is reduced to 41 per cent for immature volume and to 57 per cent in the all-aged stands (fig. 11). The volume of the trees 10 inches d.b.h. and over for the hardwood species occurs as follows: 84 per cent in the mature, 43 per cent in the immature and 65 per cent in the all-aged forest.

The volume relationship of the two size classes, 4–9 inches d.b.h. and 10 inches d.b.h. and over, for the principal species in mature, immature and all-aged stands, is shown in figure 12 for conifers and figure 13 for hardwoods for patented lands.

Cedar, the principal coniferous species, has 57 per cent of the mature volume in the 10-inch and over group, while 76 per cent of the immature and 63 per cent of the all-aged volume occur in the 4 to 9-inch size class. White pine, hemlock and white spruce produce principally sawlog material in all age classes. In the mature stands, the sawlog size

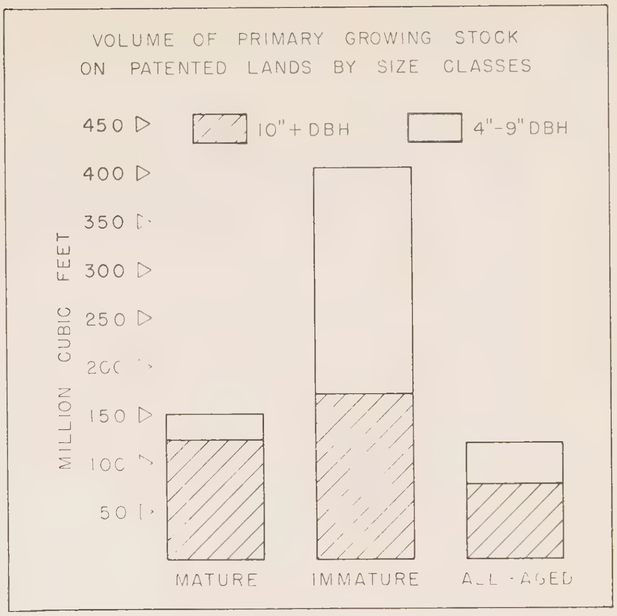


FIGURE 11

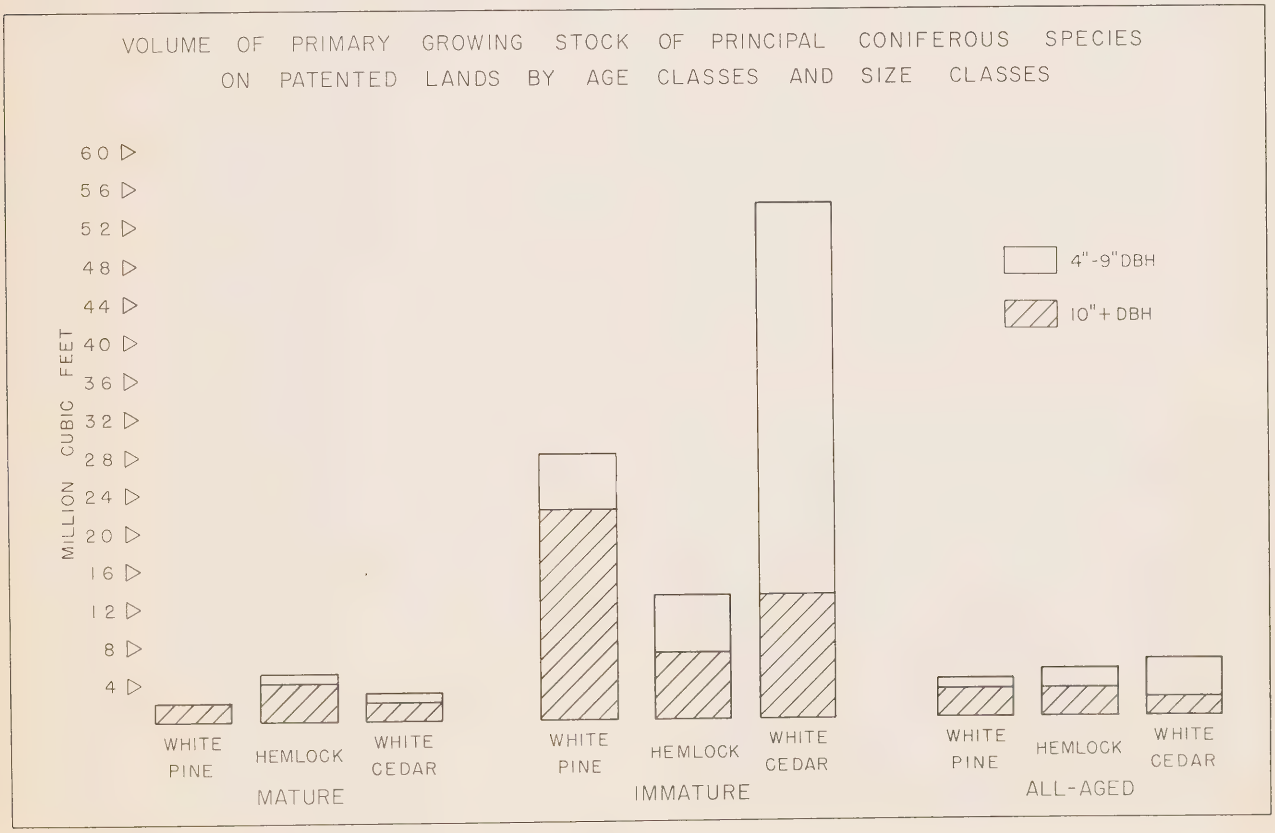


FIGURE 12

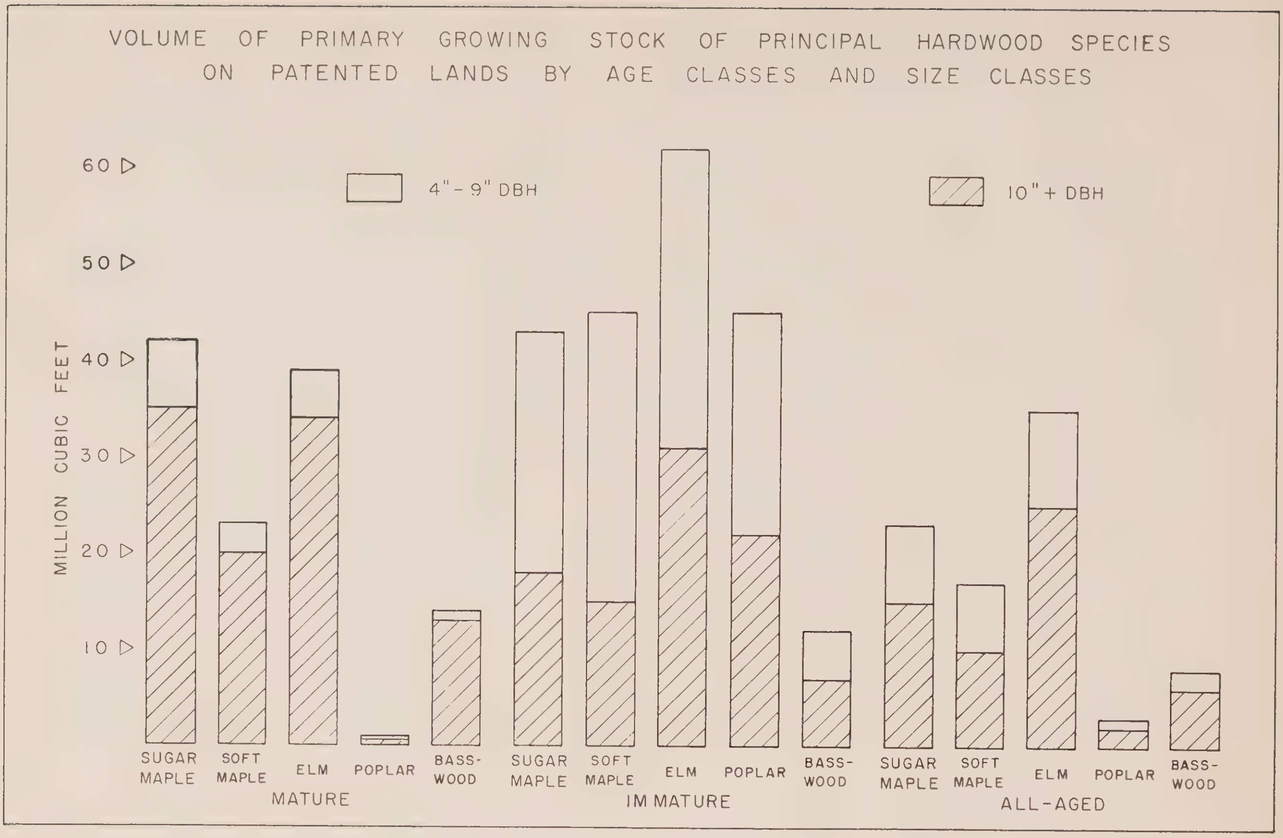


FIGURE 13

class contains 92 per cent of the white pine volume, 81 per cent of the hemlock and 84 per cent of the white spruce. The relative percentages in the immature stands are: white pine 78 per cent, hemlock 57 per cent and white spruce 58 per cent. In the all-aged stands these become: 82 per cent for white pine, 67 per cent for hemlock and 74 per cent for white spruce. The pulpwood size class contains

Plantation thinned for pulpwood.

77 per cent of the mature, 84 per cent of the immature and 83 per cent of the balsam fir volume in all-aged stands.

The five principal hardwood species produce mainly sawlog material in both the mature and all-aged stands. Elm has 87 per cent of the mature and 71 per cent of the all-aged volume in this larger size class. The respective percentages for sugar maple are 84 and 64; for soft maple, 86 and 59; for poplar, 74 and 73; and for basswood, 92 and 80. The immature age class is more evenly distributed between the two diameter groups. Elm has 50 per cent in each size class, while sugar maple has 57 per cent in the 4 to 9-inch class and 43 per cent in the 10-inch and over class. Soft maple has 66 per cent in the smaller size class, poplar 52 per cent and basswood only 43 per cent.

Crown lands have a total volume of just over 10 million cubic feet. The immature hardwoods, with 7 million cubic feet, make up 70 per cent of the total volume. The size relationships of the principal hardwood species in this age class are shown in figure 14.

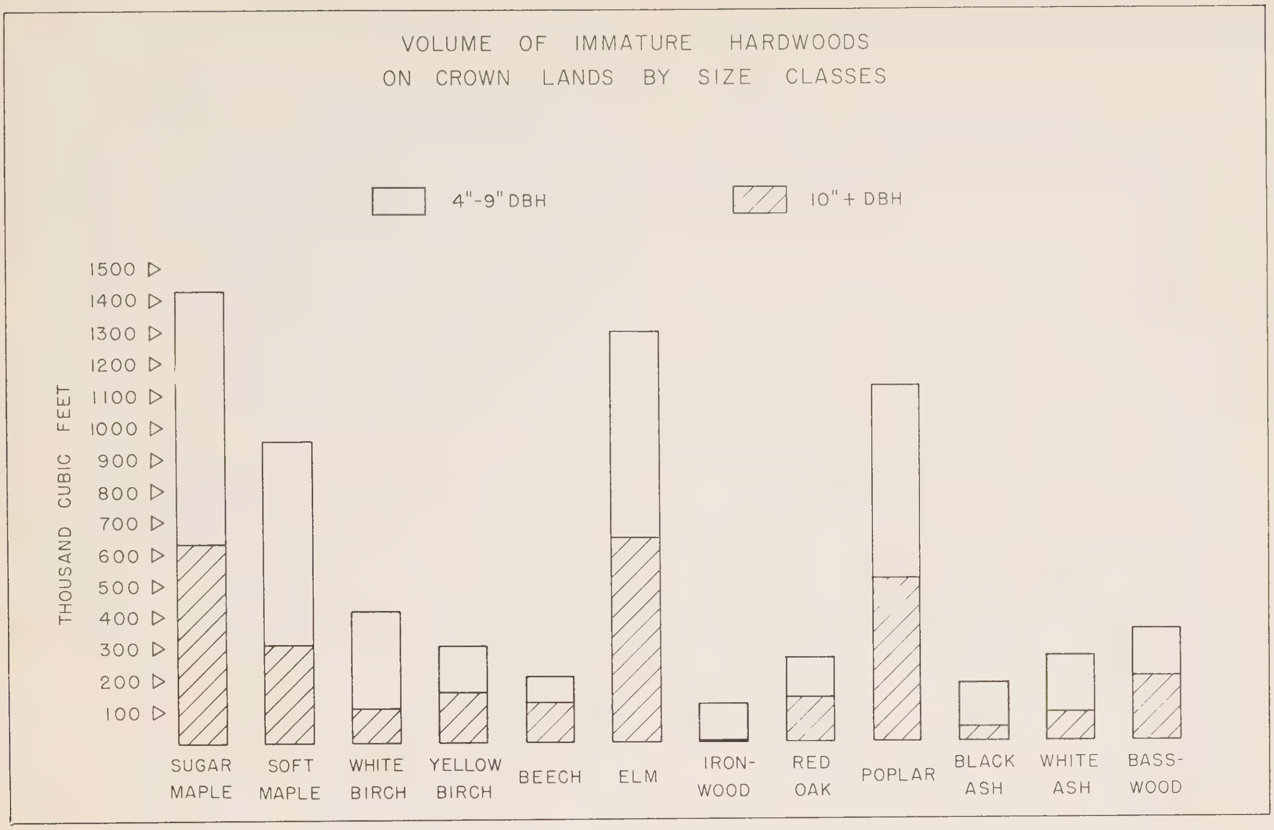


FIGURE 14

Allowable Cut

The allowable cut has been computed for each species with the aid of a volumetric formula[1] and appropriate rotation[2] for the species. Thus the amount of the allowable cut results from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

The calculation of allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. This is because of woods operations being carried out and the present stands growing in volume each year. Therefore, the size and structure of the primary growing stock, regarded as the foundation of the allowable cut calculations, also change from year to year; and for that reason, on expiration of the initial ten-year period, the allowable cut should be recalculated. With effective forestry practices, allowable cuts for the valuable species will increase; without them the proportion of less desirable species in the stands will grow greater.

The annual allowable cut, or net depletion allowable under management in the Kemptville district, is 18,145,121 cubic feet: 177,228 cubic feet from Crown lands and 17,967,893 cubic feet from patented lands. Of the total allowable cut, 99 per cent is on patented lands and only one per cent on Crown lands.

CROWN LAND

The annual allowable cut for Crown lands represents 1.8 per cent of the primary growing stock, or 13.4 cubic feet per acre of the productive forest area. Coniferous species comprise 30,775 cubic feet, or 17 per cent, of the total allowable cut; and hardwood species (table 12) total 146,453 cubic feet, or 83 per cent of the cut.

The low volume per acre that may be cut from Crown lands on a sustained basis results from the fact that only 50 per cent of the productive forest lands contained trees 3.6 inches d.b.h. and over. The remaining Crown lands are in the process of rehabilitation and support young growth in the form of natural regeneration or plantations. In

[1] Method of calculation of allowable cut is given in Appendix, methods, allowable cut, page 29.

[2] Rotation, by species, table 15, page 29.

view of the small volume available from Crown lands, no detailed analysis of allowable cut by species has been made.

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Kemptville district.*

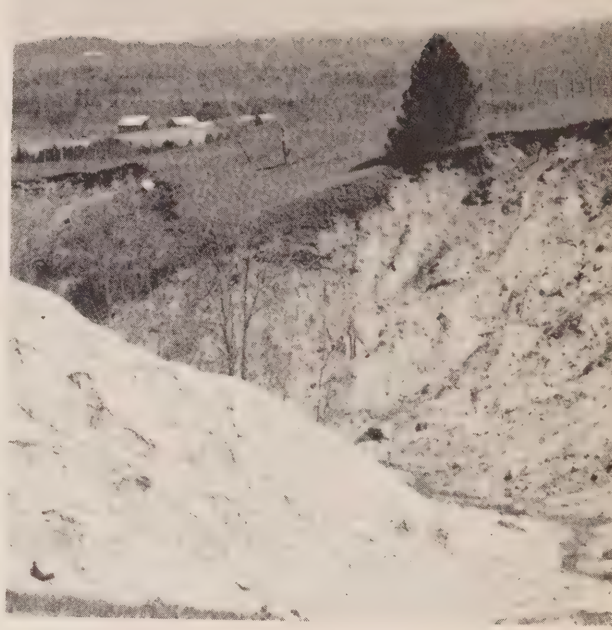
Species	Annual allowable cut cu. ft.
White pine	8,912
Red pine	879
Pitch pine	9
White spruce	3,932
Black spruce	489
Balsam fir	6,815
Hemlock	1,902
White cedar	7,102
Larch	735
TOTAL CONIFERS	30,775
Sugar maple	16,077
Soft maple	28,083
White birch	9,961
Yellow birch	4,424
Beech	2,523
Elm	17,998
Ironwood	2,475
Red oak	2,587
White oak	116
Poplar	42,724
Black ash	3,679
White ash	5,402
Basswood	8,662
Black cherry	701
Butternut	375
Hickory	666
TOTAL HARDWOODS	146,453
TOTAL ALL SPECIES	177,228

PATENTED LAND

The annual allowable cut for patented lands is 17,967,893 cubic feet, which represents 2.7 per cent of the primary growing stock or 35.7 cubic feet per acre of the productive forest land. Coniferous species comprise 18 per cent of the allowable cut and hardwoods 82 per cent.

The species content making up the annual allowable cut is shown in table 13. Four species make up 85 per cent of the coniferous allowable cut: white cedar 36 per cent, white pine 22 per cent, balsam fir 15 per cent and white spruce 12 per cent.

Eighty-six per cent of the hardwood allowable cut is contributed by five species. Soft maple provides 27 per cent of the allowable cut, poplar 21 per cent, elm 17 per cent, sugar maple 14 per cent and basswood 7 per cent. Figure 15 graphically illustrates the relationship of the allowable cut for a ten-year period to the volume of the primary growing stock for hardwoods.



Erosion that can be checked by reforestation.

TABLE 13. — *Annual allowable cut for all species on patented lands in the Kemptville district.*

Species	Annual allowable cut cu. ft.
White pine	703,704
Red pine	63,797
Jack pine	3,609
Pitch pine	2,322
White spruce	402,591
Black spruce	48,385
Balsam fir	485,744
Hemlock	279,343
White cedar	1,178,698
Red cedar	180
Larch	93,855
TOTAL CONIFERS	3,262,228
Sugar maple	2,020,603
Soft maple	3,917,770
White birch	554,984
Yellow birch	300,761
Beech	188,681
Elm	2,545,736
Ironwood	114,823
Red oak	208,526
White oak	38,566
Poplar	3,059,119
Black ash	230,801
White ash	348,656
Basswood	1,055,506
Black cherry	28,031
Butternut	37,864
Hickory	55,238
TOTAL HARDWOODS	14,705,665
TOTAL ALL SPECIES	17,967,893

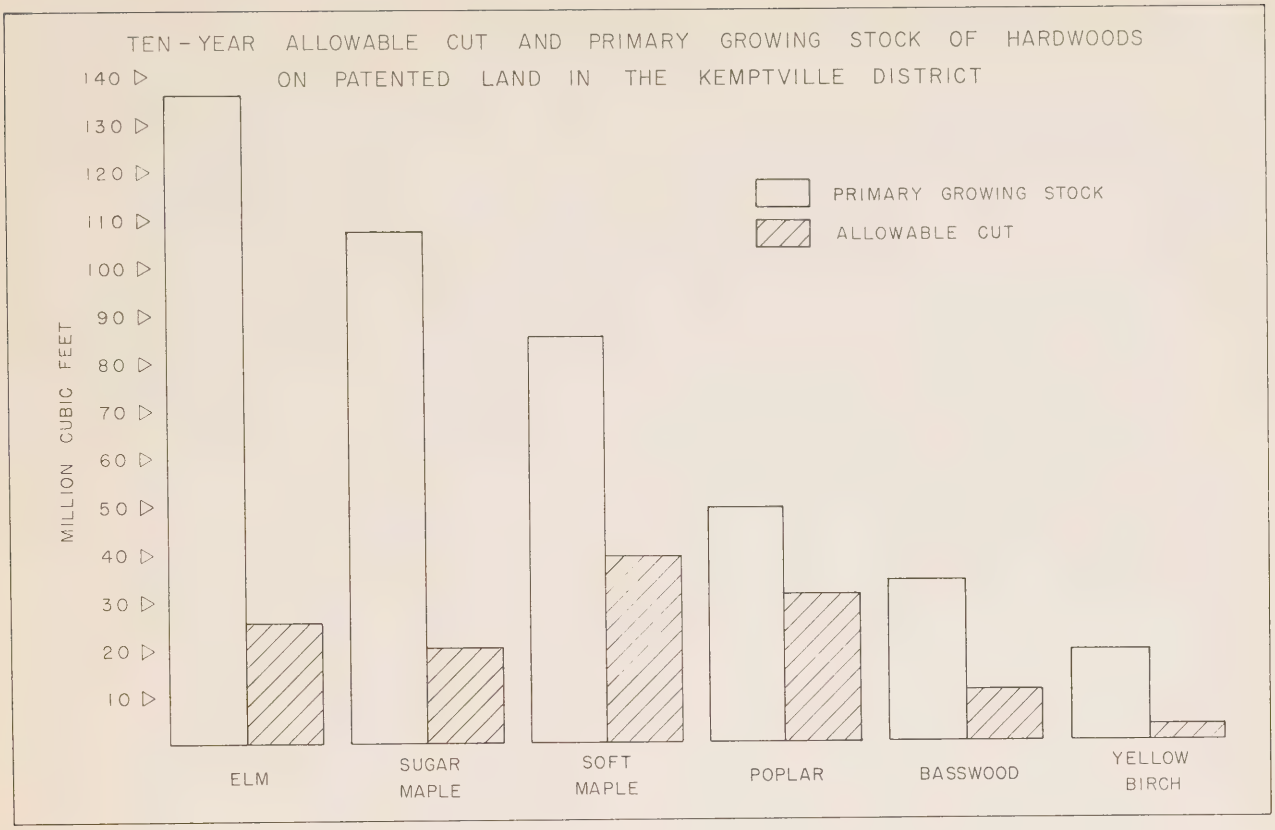


FIGURE 15

Utilization vs. Allowable Cut

Since the Kemptville district is essentially an area of privately owned land, no statistics relating to the annual cut of timber are available from the Department of Lands and Forests, Ontario. The latest information available indicates that in 1950[1], wood and forest products were cut on patented lands in the Kemptville district as follows:

Fuelwood	168,530 cords
Pulpwood	4,760 cords
Fence posts	142,950 pieces
Logs	7,534,429 board feet
Poles	1,631 pieces

These forest products were estimated[1] to have a value of $1,552,817, of which $582,419 represented cash income to the farmer, while the remainder was utilized on the farm. In addition, maple products — maple sugar and syrup — were valued at $364,625, of which $220,312 was received by the producers as cash income.

[1] Census of Canada, 1951, Volume VI, Table 27.

TABLE 14. — *Gross total cubic-foot volume of wood produced from patented land in one year in the Kemptville district.*

Fuelwood	30,478,830
Pulpwood	697,586
Posts	404,575
Logs	5,338,223
Poles	46,160
TOTAL	36,965,374

By the use of appropriate converting factors, these wood volumes are expressed in gross total cubic feet (table 14). It is impossible to separate these volumes by species, so no detailed comparison of actual and allowable cut is possible. A comparison of the total allowable cut for all species on patented lands with the actual cut indicates that the forests are being overcut annually by 18,997,481 cubic feet, which is more than the allowable cut itself.

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs on a scale of four inches to the mile (1/15840). Following the photography, semi-controlled photo maps were prepared.

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario a photo map covers 7′ 30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map, the prints are mounted on a hard surface non-porous board, such as masonite, upon which control points have been plotted. The road network of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted, and makes the edges of the prints less perceptible to the eye and the camera. After a liberal application of adhesive the print is oriented onto the control and adjusted to coincide with detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the photo map it is photographed in two sections, producing an east and west half for each sheet. Upon production of the negative, prints are readily available.

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the mosaic. Forest data were drafted on a linen overlay, and ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1949, 1952 and 1953, and field sampling was carried out in the summers of 1951 and 1954. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. These were separated into three age classes: mature, immature and all-aged. The volume per acre for each cover type for the mature and immature age classes was then summarized from the field tallies into three density classes. The all-aged stands were not segregated into density classes. Summaries were made separately for the different years during which field data were collected and for the two ecological sections in the Kemptville district. The per acre volumes in cubic feet, made up in this manner, are shown in tables 16, 17 and 18.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by taking the total mature volume for each species and dividing by the rotation age for the species. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 16 cubic feet per acre, and for patented lands 30 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years and the mature age class from 30 to 300 years, depending on the species.

[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department of Lands and Forests, Ontario, Parts II and III.

Stands classed as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered except jack pine, where a rotation of 70 years has been accepted as more suitable than that of 60 years. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 15).

TABLE 15. — *Rotation by species.*

Species	Crown land *years*	Patented land *years*
White pine	120	90
Red pine	100	60
Jack pine	70	40
Pitch pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Red cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100
Butternut	100	100
Hickory	100	100

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotations.

The compilation was carried out in such a way that volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory, for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

(b) FORMULA

In the present calculations the following formula was used:

$$P = \frac{\frac{5}{8}(V.1 + V.2 + V.3)}{n/3}$$

where:

V.1 — denotes volume of mature timber (Age Class I).
V.2 — denotes volume of immature timber (Age Class II).
V.3 — denotes volume of mature and immature timber in all-aged stands.
n — denotes rotation.
P — denotes annual allowable cut.

By application of this formula, the following figures for the annual allowable cut were obtained:

Crown lands	177,228 cubic feet
Patented lands	17,967,893 cubic feet
TOTAL	18,145,121 cubic feet

In view of the accessibility of the area and the demand for wood, the allowable cut might have been calculated so as to include volumes from intermediate cuttings. No such provision has been made in the above calculation because of the already seriously depleted growing stock in the district. The mature stands contain two-thirds of the volume that could reasonably be expected from this area. Even with this reduced volume, the ratio of V.1 : V.2 is not the normal 5 : 3, but 5 : 2.6. This indicates that the volume in the immature stands has already been greatly reduced by excessive cuttings. Until the volume in these stands has been built up to a satisfactory level, no increase in the allowable cut can be justified.

1 Manual of Timber Management, Department of Lands and Forests, Ontario — Part II, page 50.

2 L. Pardé — Traité pratique d'aménagement des forêts, Paris, 1930.

Table 16. — *Volume of the primary growing stock in cubic feet per acre. Algonquin Section — 1951*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	4	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	59.4	56.3	44.2	18.6	82.5	78.8	65.1	0.4
	10″ up	144.1	136.5	107.2	45.1	312.1	298.3	246.6	222.1
Red pine	4″–9″	18.0	17.1	13.4	5.6	16.8	16.1	13.3	14.6
	10″ up	....	....	....	....	24.7	23.6	19.5	93.1
Jack pine	4″–9″	277.4	262.9	206.4	86.8	....	....	....	49.1
	10″ up	72.9	69.1	54.2	22.8	....	....	....	....
White spruce	4″–9″	35.0	33.2	26.0	10.9	90.8	86.8	71.7	39.0
	10″ up	26.8	25.4	20.0	8.4	140.2	134.0	110.8	10.9
Black spruce	4″–9″	109.4	103.7	81.4	34.2	32.9	31.4	26.0	....
	10″ up	202.3	191.7	150.4	63.3	16.4	15.7	13.0	....
Balsam fir	4″–9″	102.1	96.7	75.9	31.9	215.3	205.8	170.1	78.8
	10″ up	62.8	59.5	46.7	19.7	49.5	47.3	39.1	....
Hemlock	4″–9″	116.7	110.6	86.8	36.5	32.5	31.1	25.6	2.6
	10″ up	249.1	236.0	185.3	78.0	55.8	53.3	44.1	....
White cedar	4″–9″	106.1	100.5	78.9	33.2	647.4	618.7	511.4	129.0
	10″ up	82.0	77.7	61.0	25.6	354.7	339.0	280.3	17.3
Larch	4″–9″	7.7	7.3	5.7	2.4	44.5	42.5	35.2	....
	10″ up	....	....	....	....	25.6	24.5	20.2	....
Total Conifers	4″–9″	831.8	788.3	618.7	260.1	1162.7	1111.2	918.4	313.5
	10″ up	840.0	795.9	624.8	262.9	979.0	935.7	773.6	343.4
Sugar maple	4″–9″	6.5	6.2	4.8	2.0	8.3	7.9	6.5	1.8
	10″ up	253.7	240.3	188.7	79.4	15.1	14.4	12.0	....
Yellow birch	4″–9″	11.5	10.9	8.6	3.6	11.9	11.4	9.4	....
	10″ up	202.3	191.7	150.4	63.3	37.4	35.7	29.6	....
Elm	4″–9″	....	....	....	....	24.0	22.9	18.9	6.1
	10″ up	154.6	146.5	115.0	48.4	22.7	21.8	18.0	....
Ironwood	4″–9″	....	....	....	....	7.0	6.7	5.6	4.4
	10″ up	....	....	....	....	0.8	0.7	0.6	....
Oak	4″–9″	....	....	....	....	....	....	....	4.4
	10″ up	....	....	....	....	....	....	....	....
White birch	4″–9″	2.7	2.6	2.0	0.9	43.3	41.4	34.2	....
	10″ up	25.6	24.3	19.1	8.0	29.4	28.1	23.2	....
Poplar (all)	4″–9″	61.2	58.0	45.5	19.2	65.2	62.4	51.5	28.3
	10″ up	101.1	95.8	75.2	31.6	119.1	113.8	94.1	174.1
Red maple	4″–9″	29.3	27.7	21.8	9.1	3.5	3.3	2.8	....
	10″ up	17.1	16.2	12.7	5.4	4.3	4.1	3.4	....
Ash	4″–9″	27.5	26.1	20.4	8.6	42.7	40.8	33.8	....
	10″ up	11.1	10.5	8.3	3.5	19.6	18.7	15.4	....
Total Hardwoods	4″–9″	138.7	131.5	103.1	43.4	205.9	196.8	162.7	45.0
	10″ up	765.5	725.3	569.4	239.6	248.4	237.3	196.3	174.1
GRAND TOTAL	4″–9″	970.5	919.8	721.8	303.5	1368.6	1308.0	1081.1	358.5
	10″ up	1605.5	1521.2	1194.2	502.5	1227.4	1173.0	969.9	517.5
TOTAL 4″ UP		2576.0	2441.0	1916.0	806.0	2596.0	2481.0	2051.0	876.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
White pine	4″–9″	....	....	....	....	7.9	7.5	5.9	4.9
	10″ up	....	....	....	....	44.4	42.0	33.0	38.5
White spruce	4″–9″	....	....	....	....	3.4	3.2	2.5	....
	10″ up	....	....	....	....	6.6	6.3	5.0	....
Balsam fir	4″–9″	10.5	10.2	8.9	6.8	23.2	22.0	17.4	7.3
	10″ up	4.8	4.7	4.1	....	4.8	4.6	3.6	2.8
Hemlock	4″–9″	15.2	14.8	12.9	8.1	10.2	9.7	7.6	....
	10″ up	128.4	125.2	108.9	22.9	28.0	26.5	20.9	....
White Cedar	4″–9″	5.3	5.2	4.5	....	10.6	10.0	7.9	....
	10″ up	13.0	12.7	11.0	5.4	7.5	7.1	5.6	....
Total Conifers	4″–9″	31.0	30.2	26.3	14.9	55.4	52.4	41.3	12.2
	10″ up	146.2	142.6	124.0	28.3	91.3	86.5	68.1	41.3

TABLE 16 (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	4	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	314.7	306.8	266.9	72.8	332.8	315.1	248.0	53.4
	10″ up	1258.7	1227.4	1067.5	773.7	308.4	292.0	229.8	79.5
Yellow birch	4″–9″	36.0	35.1	30.6	1.6	40.7	38.5	30.3	5.8
	10″ up	232.8	227.1	197.4	142.8	53.8	50.9	40.1	10.6
Beech	4″–9″	76.7	74.8	65.1	16.5	41.3	39.2	30.8	
	10″ up	286.9	279.7	243.2	59.1	67.2	63.6	50.1	
Elm	4″–9″	18.8	18.4	16.0	9.6	43.5	41.2	32.5	21.0
	10″ up	121.7	118.6	103.2	78.1	71.1	67.3	52.9	26.9
Ironwood	4″–9″	40.4	39.4	34.3	18.9	55.7	52.8	41.5	8.8
	10″ up	8.5	8.3	7.2	....	4.6	4.3	3.4	0.7
Oak	4″–9″	7.6	7.4	6.5	6.0	71.8	67.9	53.5	47.1
	10″ up	38.2	37.3	32.4	33.2	79.0	74.8	58.9	29.1
White birch	4″–9″	11.8	11.5	10.0	1.4	97.2	92.1	72.5	24.9
	10″ up	15.7	15.3	13.3	....	31.4	29.7	23.4	8.5
Poplar (all)	4″–9″	22.8	22.2	19.3	....	179.4	169.8	133.7	124.1
	10″ up	44.4	43.3	37.7	....	120.1	113.7	89.5	51.0
Red maple	4″–9″	12.7	12.4	10.8	....	43.0	40.7	32.0	29.3
	10″ up	5.6	5.5	4.7	....	17.3	16.4	12.9	14.8
Ash	4″–9″	34.9	34.0	29.6	1.8	57.9	54.8	43.1	12.0
	10″ up	53.7	52.4	45.5	49.5	28.5	27.0	21.3	8.8
Basswood	4″–9″	26.8	26.1	22.7	....	42.6	40.4	31.8	6.1
	10″ up	196.2	191.4	166.4	41.8	63.9	60.5	47.6	14.1
Black cherry	4″–9″	6.6	6.3	5.6	....	10.1	9.6	7.5	....
	10″ up	5.6	5.5	4.8	....	2.0	1.8	1.5	....
TOTAL HARDWOODS	4″–9″	609.8	594.4	517.4	128.6	1016.0	962.1	757.2	332.5
	10″ up	2268.0	2211.8	1923.3	1178.2	847.3	802.0	631.4	244.0
GRAND TOTAL	4″–9″	640.8	624.6	543.7	143.5	1071.4	1014.5	798.5	344.7
	10″ up	2414.2	2354.4	2047.3	1206.5	938.6	888.5	699.5	285.3
TOTAL 4″ UP		3055.0	2979.0	2591.0	1350.0	2010.0	1903.0	1498.0	630.0
		MIXEDWOODS MATURE (M-I)				MIXEDWOODS IMMATURE (M-II)			
White pine	4″–9″	18.3	17.3	13.6	....	86.6	80.2	61.3	30.1
	10″ up	202.0	191.2	150.1	....	303.6	281.1	214.9	148.1
Red pine	4″–9″	....	....	....	....	15.0	13.9	10.6	3.4
	10″ up	....	....	....	....	34.8	32.2	24.6	6.2
White spruce	4″–9″	28.8	27.2	21.4	....	56.8	52.6	40.2	24.0
	10″ up	81.4	77.1	60.5	....	76.8	71.1	54.4	59.1
Black spruce	4″–9″	15.3	14.5	11.4	....	8.8	8.1	6.2	
	10″ up	16.2	15.3	12.0	....	4.3	4.0	3.1	....
Balsam fir	4″–9″	136.4	129.2	101.4	2.5	211.8	196.2	150.0	33.9
	10″ up	36.7	34.7	27.3	....	42.2	39.0	29.8	18.8
Hemlock	4″–9″	106.4	100.7	79.1	54.7	40.7	37.7	28.8	13.2
	10″ up	731.5	692.5	543.7	....	61.4	56.9	43.5	39.5
White cedar	4″–9″	89.1	84.3	66.2	46.5	171.4	158.7	121.3	12.9
	10″ up	205.9	195.0	153.1	14.5	74.8	69.3	53.0	3.1
Larch	4″–9″	....	....	....	....	2.2	2.0	1.6	
	10″ up	....	....	....	....	0.4	0.4	0.3	
TOTAL CONIFERS	4″–9″	394.3	373.2	293.1	103.7	593.3	549.4	420.0	117.5
	10″ up	1273.7	1205.8	946.7	14.5	598.3	554.0	423.6	274.8
Sugar maple	4″–9″	115.7	109.5	86.0	18.3	95.4	88.3	67.6	34.8
	10″ up	612.1	579.4	454.9	450.7	77.5	71.7	54.8	96.2
Yellow birch	4″–9″	49.2	46.5	36.5	....	27.3	25.3	19.3	2.2
	10″ up	363.9	344.5	270.5	27.4	64.4	59.6	45.6	11.4
Beech	4″–9″	35.6	33.7	26.5	8.7	8.1	7.5	5.7	1.5
	10″ up	74.6	70.6	55.4	....	12.9	11.9	9.1	9.7
Elm	4″–9″	23.7	22.4	17.6	....	47.6	44.1	33.7	11.4
	10″ up	145.5	137.7	108.1	164.2	67.6	62.6	47.9	10.2

TABLE 16 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	4	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Ironwood	4″–9″	11.5	10.9	8.6	15.4	17.1	15.9	12.2	16.2
	10″ up	4.2	4.0	3.1	18.2	1.2	1.1	0.8	3.8
Oak..	4″–9″	....	....	....	....	24.0	22.2	17.0	16.8
	10″ up	....	....	....	22.4	23.1	21.4	16.4	25.5
White birch	4″–9″	41.3	39.1	30.7	....	133.9	124.0	94.8	17.5
	10″ up	68.9	65.2	51.2	19.9	59.9	55.4	42.4	4.8
Poplar (all)	4″–9″	53.7	50.9	40.0	....	258.2	239.1	182.8	45.0
	10″ up	217.7	206.1	161.8	....	278.7	258.0	197.3	67.7
Red maple....	4″–9″	43.1	40.8	32.0	....	58.4	54.1	41.3	19.6
	10″ up	74.9	70.9	55.7	....	25.4	23.5	18.0	5.2
Ash	4″–9″	80.4	76.2	59.8	29.4	66.8	61.8	47.2	4.3
	10″ up	108.4	102.6	80.6	219.4	38.0	35.2	26.9	2.9
Basswood...	4″–9″	9.4	8.9	7.0	4.1	12.6	11.7	8.9	....
	10″ up	128.3	121.4	95.3	109.1	24.1	22.3	17.0	....
Black cherry	4″–9″	2.6	2.4	1.9	....	4.2	3.9	3.0	....
	10″ up	1.3	1.3	1.0	18.6	1.0	1.0	0.7	....
TOTAL HARDWOODS	4″–9″	466.2	441.3	346.6	75.9	753.6	697.9	533.5	169.3
	10″ up	1799.8	1703.7	1337.6	1049.9	673.8	623.7	476.9	237.4
GRAND TOTAL	4″–9″	860.5	814.5	639.7	179.6	1346.9	1247.3	953.5	286.8
	10″ up	3073.5	2909.5	2284.3	1064.4	1272.1	1177.7	900.5	512.2
TOTAL 4″ UP....		3934.0	3724.0	2924.0	1244.0	2619.0	2425.0	1854.0	799.0

Road through plantation for thinning operations.

TABLE 17. — *Volume of the primary growing stock in cubic feet per acre. St. Lawrence Section — 1954*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	ALL-AGED
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	6.8	6.4	5.5	49.0	45.0	36.8	
	10″ up	256.3	240.6	204.3	140.1	128.8	105.4	
White spruce	4″–9″	29.0	27.2	23.1	44.3	46.7	33.3	
	10″ up	179.6	168.6	143.2	54.4	50.0	40.9	
Black spruce	4″–9″	2.4	2.2	1.9	39.3	36.2	29.6	
	10″ up	..			2.5	2.3	1.9	
Balsam fir	4″–9″	27.4	25.8	21.9	44.1	40.6	33.2	
	10″ up	5.8	5.4	4.6	4.4	4.0	3.3	
Hemlock	4″–9″	3.1	2.9	2.4	22.3	20.5	16.8	
	10″ up	41.9	39.4	33.5	26.2	24.1	19.7	
White cedar	4″–9″	449.1	421.6	358.2	675.9	621.4	508.3	
	10″ up	887.6	833.3	707.8	197.4	181.4	148.4	
Larch	4″–9″	8.4	7.9	6.7	57.2	52.6	43.0	
	10″ up	3.4	3.2	2.7	6.4	5.9	4.8	
TOTAL CONIFERS	4″–9″	526.2	494.0	419.7	932.1	857.0	701.0	
	10″ up	1374.6	1290.5	1096.1	431.4	396.5	324.4	
Sugar maple	4″–9″	1.3	1.2	1.0	3.3	3.0	2.5	
	10″ up	10.5	9.9	8.4	8.4	7.8	6.3	
Soft maple	4″–9″	16.0	15.0	12.8	26.4	24.3	19.9	
	10″ up	138.0	129.6	110.0	20.4	18.8	15.3	
White birch	4″–9″	5.2	4.9	4.2	24.5	22.5	18.4	
	10″ up	32.7	30.7	26.0	14.0	12.9	10.5	
Yellow birch	4″–9″	9.8	9.2	7.8	7.3	6.7	5.5	
	10″ up	11.5	10.8	9.2	7.8	7.1	5.8	
Elm	4″–9″	12.2	11.5	9.7	37.3	34.3	28.0	
	10″ up	172.7	162.1	137.7	61.4	56.4	46.2	
Ironwood	4″–9″	0.5	0.5	0.4	3.2	2.9	2.4	
	10″ up	1.9	1.7	1.5	0.2	0.2	0.1	
Poplar	4″–9″	4.2	3.9	3.3	32.3	29.7	24.3	
	10″ up	29.0	27.3	23.2	34.6	31.8	26.0	
Black ash	4″–9″	7.9	7.4	6.3	12.2	11.2	9.2	
	10″ up	1.6	1.5	1.3	1.2	1.1	0.9	
White ash	4″–9″	0.9	0.8	0.7	1.4	1.2	1.0	
	10″ up	3.8	3.6	3.1	3.6	3.4	2.8	
Basswood	4″–9″	0.8	0.8	0.7	1.5	1.4	1.1	
	10″ up	8.7	8.1	6.9	8.5	7.8	6.4	
TOTAL HARDWOODS	4″–9″	58.8	55.2	46.9	149.4	137.2	112.3	
	10″ up	410.4	385.3	327.3	160.1	147.3	120.3	
GRAND TOTAL	4″–9″	585.0	549.2	466.6	1081.5	994.2	813.3	
	10″ up	1785.0	1675.8	1423.4	591.5	543.8	444.7	
TOTAL 4″ UP		2370.0	2225.0	1890.0	1673.0	1538.0	1258.0	
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	0.1	0.1	0.1	2.1	1.9	1.5	0.5
	10″ up	14.2	13.1	11.4	7.8	7.0	5.6	9.6
White spruce	4″–9″	0.6	0.5	0.5	1.1	1.0	0.8	0.7
	10″ up	2.2	2.2	1.8	2.2	2.0	1.6	3.2
Balsam fir	4″–9″	2.4	2.2	2.0	5.9	5.4	4.3	3.0
	10″ up	0.4	0.4	0.3	0.7	0.6	0.5	1.0
Hemlock	4″–9″	10.7	9.9	8.6	11.3	10.3	8.2	7.7
	10″ up	46.3	43.0	37.4	15.1	13.6	10.9	23.8
White cedar	4″–9″	7.6	7.1	6.2	17.8	16.1	12.8	12.6
	10″ up	9.5	8.8	7.6	3.7	3.3	2.7	10.7
Larch	4″–9″				1.4	1.3	1.1	
	10″ up				0.2	0.2	0.1	
TOTAL CONIFERS	4″–9″	21.4	19.8	17.4	39.6	36.0	28.7	24.5
	10″ up	72.6	67.5	58.5	29.7	26.7	21.4	48.3

Table 17 (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	128.0	118.9	103.3	145.2	131.1	104.7	163.4
	10″ up	692.8	643.4	558.8	79.5	71.8	57.4	319.1
Soft maple	4″–9″	63.8	59.2	51.4	269.6	243.5	194.5	109.7
	10″ up	412.2	382.9	332.5	126.9	114.6	91.6	159.7
White birch	4″–9″	1.6	1.5	1.3	19.4	17.6	14.0	3.2
	10″ up	1.2	1.1	1.0	3.7	3.3	2.7	2.4
Yellow birch	4″–9″	21.1	19.6	17.0	28.0	25.3	20.2	22.1
	10″ up	38.7	36.0	31.3	11.6	10.5	8.4	21.3
Beech	4″–9″	15.3	14.2	12.3	10.7	9.7	7.7	9.5
	10″ up	98.7	91.7	79.6	12.4	11.2	9.0	32.6
Elm	4″–9″	102.1	94.9	82.4	269.1	243.0	194.2	159.3
	10″ up	695.9	646.3	561.3	234.8	212.1	169.4	367.5
Ironwood	4″–9″	14.7	13.7	11.9	11.2	10.0	8.0	19.6
	10″ up	2.4	2.2	1.9	0.4	0.4	0.3	1.6
Red oak	4″–9″	....	....	....	1.1	1.0	0.8	0.7
	10″ up	....	....	....	3.9	3.5	2.8	3.5
White oak	4″–9″	0.9	0.8	0.7	2.0	1.8	1.4	2.5
	10″ up	7.7	7.1	6.2	3.0	2.7	2.2	6.8
Poplar (all)	4″–9″	2.1	1.9	1.7	62.9	56.8	45.3	8.3
	10″ up	6.5	6.0	5.2	34.6	31.2	25.0	26.7
Black ash	4″–9″	23.6	21.9	19.0	29.8	26.9	21.5	16.9
	10″ up	10.6	9.9	8.6	3.2	2.9	2.3	2.7
White ash	4″–9″	18.0	16.7	14.5	59.6	53.9	43.0	28.8
	10″ up	76.0	70.7	61.4	27.9	25.2	20.2	42.4
Basswood	4″–9″	23.2	21.5	18.7	44.5	40.2	32.1	28.6
	10″ up	270.4	251.1	218.1	51.3	46.3	37.0	114.6
Black cherry	4″–9″	0.8	0.8	0.7	6.3	5.7	4.5	1.5
	10″ up	2.0	1.9	1.6	2.0	1.8	1.5	1.9
Butternut	4″–9″	2.0	1.8	1.6	4.4	4.0	3.2	2.0
	10″ up	9.4	8.8	7.6	5.5	4.9	3.9	9.1
Hickory	4″–9″	5.6	5.2	4.5	14.9	13.4	10.7	7.3
	10″ up	8.7	8.0	7.0	3.3	3.0	2.4	9.9
Total Hardwoods	4″–9″	422.8	392.6	341.0	978.7	883.9	705.8	583.4
	10″ up	2333.2	2167.1	1882.1	604.0	545.4	436.1	1121.8
GRAND TOTAL	4″–9″	444.2	412.4	358.4	1018.3	919.9	734.5	607.9
	10″ up	2405.8	2234.6	1940.6	633.7	572.1	457.5	1170.1
TOTAL 4″ UP		2850.0	2647.0	2299.0	1652.0	1492.0	1192.0	1778.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	4.1	4.0	3.5	14.1	13.4	11.1	19.3
	10″ up	129.7	124.8	110.3	55.6	52.4	43.5	81.3
White spruce	4″–9″	7.0	6.7	5.9	19.5	18.4	15.3	13.7
	10″ up	49.6	47.8	42.2	24.3	22.9	19.0	33.9
Black spruce	4″–9″	....	....	....	9.6	9.1	7.5	....
	10″ up	....	....	....	0.1	0.1	0.1	....
Balsam fir	4″–9″	18.8	18.2	16.0	40.5	38.2	31.7	19.3
	10″ up	4.3	4.1	3.7	3.3	3.1	2.6	2.3
Hemlock	4″–9″	72.6	69.9	61.7	39.8	37.6	31.2	39.3
	10″ up	305.6	294.4	259.9	42.8	40.4	33.6	90.0
White cedar	4″–9″	105.7	101.8	89.9	246.5	232.8	193.2	172.7
	10″ up	136.2	131.1	115.8	48.4	45.7	37.9	102.6
Larch	4″–9″	....	....	....	20.5	19.3	16.1	11.5
	10″ up	....	....	....	3.8	3.6	3.0	4.4
Total Conifers	4″–9″	208.2	200.6	177.0	390.5	368.8	306.1	275.8
	10″ up	625.4	602.2	531.9	178.3	168.2	139.7	314.5

TABLE 17 (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	56.6	54.5	48.1	14.8	14.0	11.6	36.2
	10″ up	344.8	332.1	293.2	12.7	12.0	10.0	80.8
Soft maple	4″–9″	50.7	48.9	43.1	140.3	132.5	109.9	79.0
	10″ up	242.6	233.6	206.3	101.1	95.5	79.3	109.6
White birch	4″–9″	6.6	6.3	5.6	63.7	60.1	49.9	12.6
	10″ up	8.8	8.6	7.5	17.3	16.4	13.6	9.0
Yellow birch	4″–9″	29.5	28.4	25.1	43.2	40.8	33.9	37.3
	10″ up	86.3	83.1	73.4	26.5	25.0	20.7	32.6
Beech	4″–9″	12.0	11.6	10.2	3.0	2.8	2.3	1.6
	10″ up	83.2	80.1	70.7	8.3	7.9	6.6	8.2
Elm	4″–9″	58.4	56.3	49.7	177.5	167.6	139.1	142.5
	10″ up	458.8	441.8	390.1	178.9	169.0	140.3	370.7
Ironwood	4″–9″	8.2	7.9	7.0	4.5	4.2	3.5	8.6
	10″ up	2.1	2.0	1.7	0.4	0.4	0.3	0.8
Red oak	4″–9″	....	....	....	0.9	0.9	0.7	1.4
	10″ up				2.3	2.2	1.8	3.1
White oak	4″–9″	0.5	0.5	0.5	0.6	0.6	0.5	0.7
	10″ up	7.2	6.9	6.1	1.0	0.9	0.8	9.6
Poplar (all)	4″–9″	3.8	3.6	3.2	84.5	79.8	66.3	16.8
	10″ up	16.8	16.2	14.3	95.3	90.0	74.7	44.5
Black ash	4″–9″	20.6	19.8	17.5	32.3	30.5	25.3	26.9
	10″ up	5.1	5.0	4.4	3.3	3.2	2.6	4.0
White ash	4″–9″	8.3	8.0	7.1	12.7	12.1	10.0	8.4
	10″ up	43.2	41.6	36.7	6.7	6.3	5.2	11.6
Basswood	4″–9″	15.3	14.7	13.0	5.3	5.0	4.1	13.0
	10″ up	164.8	158.7	140.2	10.9	10.3	8.6	54.2
Black cherry	4″–9″	....	....	....	1.0	1.0	0.8	0.4
	10″ up	....	....	....	0.6	0.5	0.5	0.9
Butternut	4″–9″	0.3	0.3	0.3	0.4	0.4	0.4	2.6
	10″ up	2.3	2.2	1.9	1.2	1.1	0.9	7.9
Hickory	4″–9″	1.8	1.7	1.5	....	....	....	3.4
	10″ up	0.8	0.8	0.7	....	....	....	1.8
TOTAL HARDWOODS	4″–9″	272.6	262.5	231.9	584.7	552.3	458.3	391.4
	10″ up	1466.8	1412.7	1247.2	466.5	440.7	365.9	749.3
GRAND TOTAL	4″–9″	480.8	463.1	408.9	975.2	921.1	764.4	667.2
	10″ up	2092.2	2014.9	1779.1	644.8	608.9	505.6	1063.8
TOTAL 4″ UP		2573.0	2478.0	2188.0	1620.0	1530.0	1270.0	1731.0

Table 18. — *Volume of the primary growing stock in cubic feet per acre.*
Algonquin Section — 1954-1955

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	ALL-AGED
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	240.2	223.7	167.6	117.6	114.3	87.2	....
	10″ up	1044.1	972.2	728.8	296.5	288.2	219.8	....
Pitch pine	4″–9″	....	....	....	7.0	6.9	5.2	....
	10″ up	....	....	....	5.3	5.1	3.9	....
White spruce	4″–9″	5.2	4.9	3.7	13.8	13.5	10.3	....
	10″ up	9.7	9.0	6.7	33.3	32.3	24.7	....
Black spruce	4″–9″	....	....	....	43.1	41.9	31.9	....
	10″ up	....	....	....	12.2	11.9	9.1	....
Balsam fir	4″–9″	....	....	....	59.0	57.3	43.8	....
	10″ up	....	....	....	16.8	16.4	12.5	....
Hemlock	4″–9″	35.4	33.0	24.7	40.4	39.3	30.0	....
	10″ up	158.3	147.4	110.5	101.0	98.2	74.9	....
White cedar	4″–9″	338.8	315.5	236.5	731.5	711.2	542.4	....
	10″ up	284.0	264.5	198.2	154.1	149.8	114.3	....
Red cedar	4″–9″	....	....	....	1.9	1.9	1.4	....
	10″ up	....	....	....	0.2	0.1	0.1	....
Larch	4″–9″	3.0	2.8	2.1	51.2	49.8	38.0	....
	10″ up	....	....	....	10.3	10.0	7.6	....
Total Conifers	4″–9″	622.6	579.9	434.6	1065.5	1036.1	790.2	....
	10″ up	1496.1	1393.1	1044.2	629.7	612.0	466.9	....
Sugar maple	4″–9″	5.6	5.2	3.9	5.1	4.9	3.7	....
	10″ up	42.1	39.2	29.4	5.2	5.1	3.9	....
Soft maple	4″–9″	....	....	....	18.5	18.0	13.7	....
	10″ up	23.8	22.2	16.6	12.2	11.9	9.1	....
White birch	4″–9″	13.3	12.4	9.3	10.4	10.1	7.8	....
	10″ up	19.5	18.1	13.6	6.0	5.8	4.4	....
Yellow birch	4″–9″	6.6	6.1	4.6	10.1	9.9	7.5	....
	10″ up	14.3	13.3	10.0	4.3	4.1	3.1	....
Beech	4″–9″	6.4	5.9	4.5	4.3	4.2	3.2	....
	10″ up	38.3	35.7	26.7	3.9	3.8	2.9	....
Elm	4″–9″	49.7	46.3	34.7	58.2	56.5	43.1	....
	10″ up	269.2	250.6	187.9	77.1	75.0	57.2	....
Ironwood	4″–9″	11.9	11.1	8.3	1.7	1.6	1.2	....
	10″ up	....	....	....	0.4	0.4	0.3	....
Red oak	4″–9″	....	....	....	1.9	1.9	1.4	....
	10″ up	107.3	99.9	74.9	12.5	12.1	9.2	....
White oak	4″–9″	5.1	4.8	3.6	4.9	4.8	3.6	....
	10″ up	69.4	64.6	48.4	17.6	17.1	13.1	....
Poplar (all)	4″–9″	1.3	1.2	0.9	21.5	20.9	16.0	....
	10″ up	25.5	23.8	17.8	44.1	42.9	32.7	....
Black ash	4″–9″	3.0	2.8	2.1	19.0	18.5	14.1	....
	10″ up	....	....	....	1.5	1.4	1.1	....
White ash	4″–9″	....	....	....	2.8	2.7	2.0	....
	10″ up	....	....	....	1.3	1.3	1.0	....
Basswood	4″–9″	....	....	....	3.6	3.5	2.7	....
	10″ up	149.0	138.8	104.0	6.7	6.5	4.9	....
Total Hardwoods	4″–9″	102.9	95.8	71.9	162.0	157.5	120.0	....
	10″ up	758.4	706.2	529.3	192.8	187.4	142.9	....
GRAND TOTAL	4″–9″	725.5	675.7	506.5	1227.5	1193.6	910.2	....
	10″ up	2254.5	2099.3	1573.5	822.5	799.4	609.8	....
TOTAL 4″ UP		2980.0	2775.0	2080.0	2050.0	1993.0	1520.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	1.7	1.7	1.1	10.3	9.0	6.4	5.8
	10″ up	26.2	23.5	17.6	31.8	27.7	19.7	26.3
White spruce	4″–9″	0.6	0.5	0.4	0.6	0.6	0.4	0.9
	10″ up	2.5	2.3	1.7	1.1	0.9	0.6	1.3

Table 18 (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Balsam fir	4″–9″	2.4	2.2	1.6	1.6	1.4	0.9	1.7
	10″ up	0.7	0.6	0.5	0.1	0.1	0.1	0.5
Hemlock	4″–9″	12.2	11.0	8.2	12.2	10.6	7.6	12.3
	10″ up	49.8	44.6	33.4	9.7	8.5	6.0	23.3
White cedar	4″–9″	10.5	9.5	7.1	12.8	11.1	7.9	12.7
	10″ up	8.1	7.2	5.4	2.4	2.1	1.5	4.2
Red cedar	4″–9″							
	10″ up							0.1
Larch	4″–9″	....	....	....	....	....	....	0.3
	10″ up							0.1
Total Conifers	4″–9″	27.4	24.7	18.4	37.5	32.7	23.2	33.7
	10″ up	87.3	78.2	58.6	45.1	39.3	27.9	55.8
Sugar maple	4″–9″	145.4	130.4	97.7	180.0	157.1	111.6	111.4
	10″ up	685.4	614.9	460.5	47.3	41.2	29.3	127.7
Soft maple	4″–9″	94.7	85.0	63.7	191.7	167.2	118.9	97.7
	10″ up	472.6	423.9	317.5	109.7	95.7	68.0	144.9
White birch	4″–9″	2.3	2.1	1.6	41.1	35.9	25.5	12.0
	10″ up	3.9	3.5	2.6	9.4	8.2	5.8	9.2
Yellow birch	4″–9″	23.3	21.0	15.7	16.0	14.0	10.0	22.0
	10″ up	29.4	26.3	19.7	5.9	5.1	3.6	19.1
Beech	4″–9″	36.0	32.3	24.2	18.1	15.8	11.3	16.7
	10″ up	131.4	117.9	88.3	7.2	6.2	4.4	28.0
Elm	4″–9″	120.2	107.8	80.7	149.4	130.3	92.6	131.4
	10″ up	763.3	684.8	512.9	145.3	126.8	90.1	324.1
Ironwood	4″–9″	22.7	20.3	15.3	32.9	28.7	20.4	20.5
	10″ up	2.1	1.9	1.4	0.8	0.7	0.5	1.0
Red oak	4″–9″	3.3	3.0	2.2	65.5	57.2	40.6	19.4
	10″ up	55.6	49.8	37.4	99.5	86.8	61.7	76.5
White oak	4″–9″	3.1	2.7	2.1	24.8	21.6	15.4	12.1
	10″ up	37.2	33.4	25.0	15.6	13.6	9.7	21.8
Poplar (all)	4″–9″	6.4	5.7	4.3	86.2	75.2	53.4	16.5
	10″ up	12.2	11.0	8.2	80.5	70.2	49.9	32.7
Black ash	4″–9″	43.6	39.1	29.3	65.7	57.3	40.7	51.3
	10″ up	18.4	16.5	12.4	5.0	4.4	3.1	7.5
White ash	4″–9″	13.9	12.5	9.3	44.4	38.7	27.5	21.2
	10″ up	57.4	51.5	38.6	23.0	20.1	14.3	30.4
Basswood	4″–9″	12.4	11.1	8.3	56.5	49.3	35.0	18.7
	10″ up	155.0	139.1	104.2	53.0	46.2	32.9	70.9
Black cherry	4″–9″	1.1	1.0	0.7	2.7	2.3	1.7	1.1
	10″ up	2.0	1.8	1.4	0.7	0.6	0.4	0.8
Butternut	4″–9″	1.5	1.3	1.0	2.2	1.9	1.4	2.0
	10″ up	10.9	9.8	7.3	4.5	4.0	2.8	4.4
Hickory	4″–9″	6.8	6.1	4.6	13.6	11.9	8.4	5.8
	10″ up	11.8	10.6	7.9	3.2	2.8	2.0	4.7
Total Hardwoods	4″–9″	536.7	481.4	360.7	990.8	864.4	614.4	559.8
	10″ up	2448.6	2196.7	1645.3	610.6	532.6	378.5	903.7
GRAND TOTAL	4″–9″	564.1	506.1	379.1	1028.3	897.1	637.6	593.5
	10″ up	2535.9	2274.9	1703.9	655.7	571.9	406.4	959.5
TOTAL 4″ UP		3100.0	2781.0	2083.0	1684.0	1469.0	1044.0	1553.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	51.8	50.8	45.4	47.5	46.4	36.2	33.8
	10″ up	372.7	365.7	327.2	92.9	90.8	71.0	132.2
Red pine	4″–9″	....	....	....	1.2	1.2	0.9	....
	10″ up	....	....	....	0.6	0.5	0.4	
Pitch pine	4″–9″	....	....	....	1.1	1.1	0.9	1.5
	10″ up	....	....	....	2.4	2.3	1.8	2.4

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White spruce	4″–9″	4.1	4.0	3.6	10.7	10.4	8.2	3.3
	10″ up	27.9	27.4	24.5	17.4	17.0	13.2	13.2
Black spruce	4″–9″	....	....	....	1.5	1.4	1.1	0.2
	10″ up	....	....	....	0.3	0.3	0.2	....
Balsam fir	4″–9″	7.3	7.2	6.5	24.8	24.3	18.9	10.6
	10″ up	8.7	8.5	7.6	5.0	4.9	3.9	2.9
Hemlock	4″–9″	84.3	82.7	74.0	99.0	96.8	75.6	76.5
	10″ up	236.1	231.6	207.2	67.7	66.1	51.7	109.4
White cedar	4″–9″	112.2	110.0	98.5	200.9	196.5	153.5	108.6
	10″ up	90.7	89.0	79.6	32.4	31.7	24.8	52.1
Red cedar	4″–9″	....	....	....	....	....	....	0.7
	10″ up	....	....	....	....	....	....	....
Larch	4″–9″	1.3	1.2	1.1	14.2	13.9	10.9	3.5
	10″ up	1.4	1.4	1.2	1.6	1.5	1.2	2.0
Total Conifers	4″–9″	261.0	255.9	229.1	400.9	392.0	306.2	238.7
	10″ up	737.5	723.6	647.3	220.3	215.1	168.2	314.2
Sugar maple	4″–9″	62.2	61.1	54.6	39.7	38.8	30.3	51.5
	10″ up	268.9	263.7	235.9	30.5	29.8	23.3	69.4
Soft maple	4″–9″	44.9	44.0	39.4	119.8	117.0	91.5	58.5
	10″ up	142.0	139.3	124.6	69.7	68.2	53.2	79.6
White birch	4″–9″	6.0	5.9	5.3	49.3	48.1	37.6	15.2
	10″ up	12.7	12.4	11.1	13.9	13.6	10.6	11.4
Yellow birch	4″–9″	24.8	24.4	21.8	23.8	23.2	18.2	31.0
	10″ up	52.6	51.6	46.1	14.8	14.5	11.3	37.7
Beech	4″–9″	17.3	16.9	15.1	10.5	10.3	8.0	10.0
	10″ up	84.2	82.6	73.9	7.1	6.9	5.4	19.2
Elm	4″–9″	71.7	70.3	62.9	160.6	157.0	122.6	88.9
	10″ up	406.2	398.6	356.6	183.3	179.2	140.1	254.4
Ironwood	4″–9″	18.6	18.3	16.3	13.3	13.0	10.2	13.4
	10″ up	8.1	7.9	7.1	0.7	0.7	0.5	1.1
Red oak	4″–9″	4.3	4.2	3.8	20.8	20.3	15.9	9.6
	10″ up	91.8	90.1	80.5	35.4	34.6	27.0	60.8
White oak	4″–9″	11.4	11.2	10.0	12.3	12.0	9.4	15.9
	10″ up	66.0	64.8	57.9	15.8	15.4	12.0	31.6
Poplar (all)	4″–9″	7.9	7.8	7.0	74.6	72.9	57.0	17.9
	10″ up	40.2	39.3	35.2	120.2	117.6	91.8	46.2
Black ash	4″–9″	35.8	35.0	31.4	57.8	56.4	44.1	41.4
	10″ up	12.3	12.1	10.8	5.4	5.3	4.1	6.4
White ash	4″–9″	6.0	5.8	5.2	8.4	8.2	6.5	11 0
	10″ up	28.7	28.2	25.3	7.4	7.2	5.6	15.5
Basswood	4″–9″	7.9	7.8	6.9	13.0	12.8	10.0	10.6
	10″ up	117.6	115.3	103.2	16.8	16.4	12.8	47.3
Black cherry	4″–9″	0.6	0.6	0.5	0.9	0.9	0.7	1.7
	10″ up	2.1	2.0	1.8	0.9	0.8	0.6	2.1
Butternut	4″–9″	0.3	0.3	0.3	2.7	2.6	2.1	0.5
	10″ up	5.0	4.9	4.4	2.6	2.5	1.9	3.5
Hickory	4″–9″	4.9	4.8	4.3	1.3	1.2	0.9	2.1
	10″ up	8.5	8.3	7.4	0.5	0.5	0.4	1.7
Total Hardwoods	4″–9″	324.6	318.4	284.8	608.8	594.7	465.0	379.2
	10″ up	1346.9	1321.1	1181.8	525.0	513.2	400.6	687.9
GRAND TOTAL	4″–9″	585.6	574.3	513.9	1009.7	986.7	771.2	617.9
	10″ up	2084.4	2044.7	1829.1	745.3	728.3	568.8	1002.1
TOTAL 4″ UP		2670.0	2619.0	2343.0	1755.0	1715.0	1340.0	1620.0

Common and Botanical Names of Tree Species included in Timber Estimates

CONIFERS

White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Jack pine	*Pinus Banksiana Lamb.*
Pitch pine	*Pinus rigida Mill.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Red cedar	*Juniperus virginiana L.*
Larch	*Larix laricina (Du Roi) K. Koch*

HARDWOODS

Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.*
	Acer saccharinum L.
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.*
	Ulmus rubra Muhl.
	Ulmus Thomasi Sarg.
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.*
White oak	*Quercus alba L.*
Poplar	*Populus tremuloides Michx.*
	Populus balsamifera L.
	Populus grandidentata Michx.
	Populus deltoides Marsh.
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.*
	Fraxinus pennsylvanica Marsh.
	Var. subintegerrima (Vahl) Fern.
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch*
	Carya cordiformis (Wang.) K. Koch

Notes

Hon. C. E. Mapledoram

Minister

F. A. MacDougall

Deputy Minister

Report No. 18 of the

TWEED DISTRICT

Forest Resources Inventory

— 1957 —

Division of Timber Management

Ontario Department of Lands and Forests

Forest Resources Inventory

— 1957 —

Report No. 18 of the

TWEED DISTRICT

Division of Timber Management

Ontario Department of Lands and Forests

PREFACE

• The ability of modern technology to raise the living standard of all the people to a satisfactory and continually rising level may be limited, in the future, by the availability of raw materials. As the definitely exhaustible resources — such as minerals — become scarcer, the renewable resources — such as trees — become increasingly important to industry.

History shows, however, that until forest products become locally or nationally scarce, exploitation is commonly tolerated, and an insistent realization of the need for forestry seldom arises until the supply of renewable resources reaches a critical condition. This condition is now faced by the wood-using industries of Southern Ontario which are, to a considerable extent, dependent upon distant sources of supply.

The restoration of local areas of depleted forest land to productivity, the building up of an adequate growing stock of timber, and the establishment of good forest management are thus matters of prime importance to this area. Secondary benefits in the control of stream flow and maintenance of water levels are increasingly important as population and industries continue to expand at a rapid rate. With the trend towards urban living, the recreational value of forested areas becomes additionally significant.

To determine the status of our forest resource, its importance in the social and economic life of the province, and the problems involved in its development, the Department of Lands and Forests has, in recent years, undertaken a province-wide survey.

The extension of this survey to include the southern agricultural areas was authorized in 1952, and work was started by the Division of Timber Management early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Department of Lands and Forests has established twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the eighteenth in the series, deals with the results of the inventory in the Tweed district.

CONTENTS

FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Tweed district, excluding land administered by the Federal Government, is 4,456,670 acres, or 6,964 square miles. Inland water surface covers 6 per cent of this area.

2. When the total land area within the district, including Federal lands, is considered, productive forest land occupies 53 per cent and non-productive forest covers 8 per cent. Areas devoted to agriculture total 36 per cent and are made up of developed agricultural land, occupying 22 per cent of the land area, grass and meadow on 11 per cent and wooded pasture on 3 per cent. The remaining 3 per cent is made up of Federal lands, non-reproducing burn and unclassified land.

3. Crown lands cover 30 per cent and patented lands 70 per cent of the total land area. When only productive forest land is considered, 959,352 acres, or 43 per cent, is under Crown ownership and 1,284,555 acres, or 57 per cent, are privately owned.

4. The age-class distribution for the productive forest lands of the district shows: 5 per cent mature, 85 per cent immature, 4 per cent all-aged, 6 per cent young growth and less than one per cent reproducing forest.

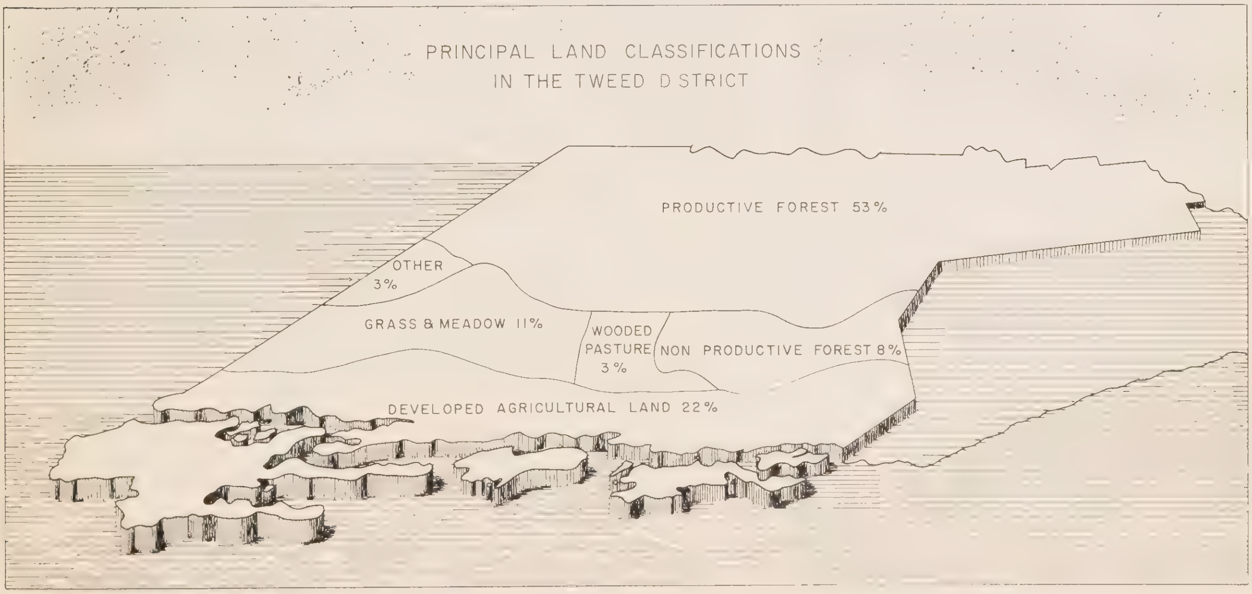
5. The hardwood type occupies 53 per cent of the productive forest area, the mixedwoods type covers 43 per cent and the coniferous type only 4 per cent.

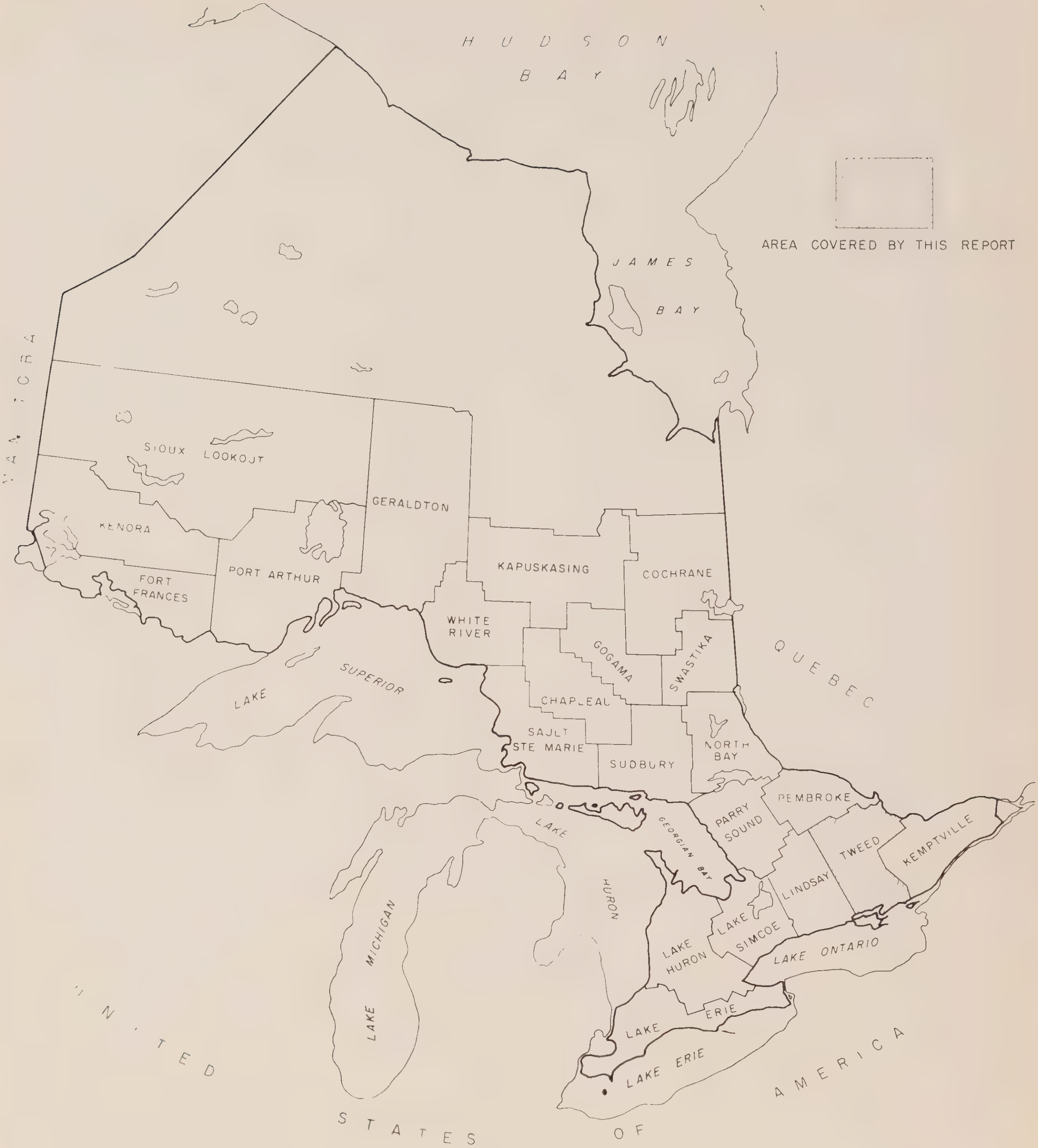
6. The volume of the primary growing stock in the Tweed district is 3,213 million cubic feet, an average of 1,432 cubic feet per acre. Hardwoods comprise 71 per cent of the total volume. The immature age class contains 87 per cent of the volume within the district.

7. Sugar maple and poplar are the leading species in the Tweed district, comprising 19 and 15 per cent, respectively, of the primary growing stock. In the mature age class, sugar maple forms 39 per cent of the volume and poplar 3 per cent; in the immature age class, each forms 17 per cent of the volume.

8. The annual allowable cut, or total depletion allowable under sustained yield management in the Tweed district, is 54 million cubic feet.

9. A comparison of the annual allowable cut with the actual utilization of timber on Crown lands shows that red and white pine, hemlock, spruce, balsam fir, sugar maple, yellow birch, poplar and basswood are all being overcut, particularly the coniferous species.





MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Village of Tweed, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Historical Background

• The earliest settlers cleared and developed the agricultural lands in the valleys of the St. Lawrence and Ottawa River and adjacent to Lake Ontario. Early settlement was hindered by the lack of markets and poor communications. By 1790 settlement had progressed to a point where a sawmill and gristmill were established on the Moira River.

Penetration of the back townships or "hinterland" took place at a later date as a consequence of the lumber industry. Despite the lack of good agricultural soils, the farmer was able to make a fair living selling oats, hay, meat and potatoes to the lumber camps and to augment his income by working in the bush during the winter. When the lumbermen moved on, the extinction of this market resulted in the abandonment of many farms.

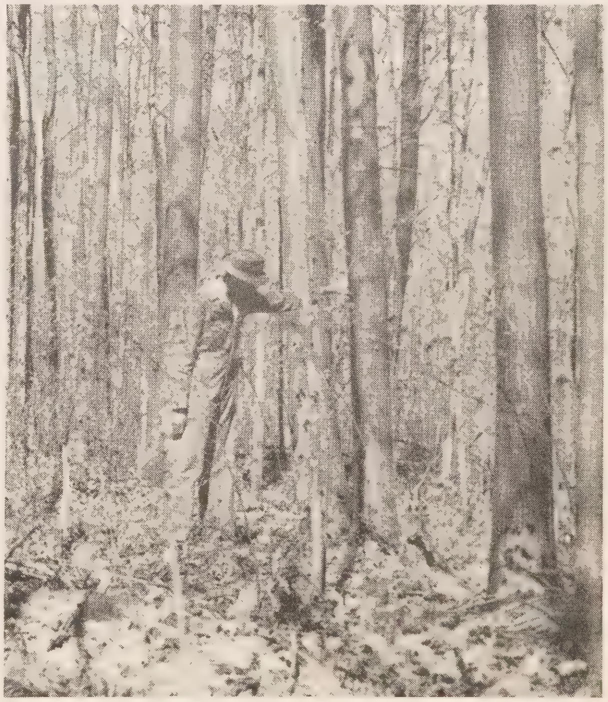
While waterways were the dominant means of transportation, Great Britain was the main Canadian market, and the square timber trade flourished — especially along the Ottawa River. Canals and lakes diverted this trade, in part, to the American market. With the construction of the railroads much of Canada was attracted into the American economic orbit. The shift to this market resulted in the establishment of a sawmilling industry.

After the timber adjacent to the lakes was removed, the watersheds drained by the streams running back into the Canadian Shield were logged. By 1856 there were 35 sawmills on the Moira River alone. After completion of the Rideau canal from Ottawa, Kingston became a concentration point for lumber. From here it was carried by schooner to Oswego, N.Y., and barged down the Erie canal. By 1850 the volume of lumber passing through Oswego had increased to 60 million board feet. Under the combined stimulus of railroad construction and the Reciprocity Treaty of 1854, lùmber production in the area back from the lakes expanded greatly.

This region contained a large supply of excellent pine, and remained in production for an unusually long time. When the lumbermen moved on, this magnificent pinery — through early exploitation and subsequent fires — had been reduced to a rocky wilderness. Later operations culled the hardwood forest for its most valuable species.

Within a century and a half the forests of this district have undergone a remarkable transformation. They have virtually disappeared from the agricultural lands along Lake Ontario and the Ottawa River. The valuable pine stands have disappeared, to be replaced by rock barrens and secondary associations of birch and aspen. The remaining hardwood and mixedwoods stands have been depleted of their more valuable species.

The transition from exploitation to management normally takes time, and requires the solution of a variety of problems involving techniques, economics and administration. In Ontario, this development was handicapped by a lack of personnel, by the depression of the nineteen-thirties and by the second world war. As staff and money became available after the war, the latest equipment and techniques were utilized to provide a forest inventory containing the information basic to a programme of forest management. During the past ten years the preparation and implementation of management plans marks the emergence of the forest economy from a pioneer phase of extraction and liquidation to one of sustained yield management.



Straight, clear red oak to be favoured in improvement cut.

Areas

The total area of the Tweed district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 4,456,670 acres (table 1), or 6,964 square miles. This area contains 77 townships and parts of three others, which comprise all, or portions, of 6 counties. Inland waters cover an area of 257,758 acres, or 6 per cent of the total area, leaving a net land area of 4,198,912 acres. Productive forest lands occupy 2,243,907 acres, or 50 per cent of the total area (fig. 1).

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	959,352	1,284,555	2,243,907
Non-forested land[2]			
Developed agricultural land	4,548	909,070	913,618
Grass and meadow land	11,103	472,420	483,523
Non-reproducing burn	4,132	3,712	7,844
Wooded pasture	4,334	135,938	140,272
Unclassified land[3]	5,120	71,198	76,318
TOTAL	29,237	1,592,338	1,621,575
Non-productive forest[4]			
Open muskeg	28,413	49,892	78,305
Treed muskeg (scrub)	1,264	1,844	3,108
Brush, alder and flooded land	52,376	130,311	182,687
Rock outcrop	28,694	40,636	69,330
TOTAL	110,747	222,683	333,430
Water	257,758	......	257,758
TOTAL AREA	1,357,094	3,099,576	4,456,670

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

[2] Productive forest lands permanently withdrawn from timber production use.

[3] Lands occupied by roads, railroads, towns, etc.

[4] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity.

Slightly more than 7 per cent of the total area is occupied by non-productive forest lands, which appear to be permanently unfit for commercial timber production, due to very low productivity. Non-forested lands, which include areas permanently withdrawn from timber production, total 1,621,575 acres, or about 36 per cent of the total area. Included in this classification are 913,618 acres of developed agricultural land and 483,523 acres of grass and meadow land (fig. 2). The 140,272 acres of wooded pasture occur within the predominantly agricultural portion of the district. These are areas of low density stands (often comprised of a few large open-grown trees with wide-spreading crowns) that are usually quite heavily grazed. This category also includes 7,844 acres of non-reproducing burn and 76,318 acres of unclassified land occupied by cities,

Sawlogs produced by good quality trees.

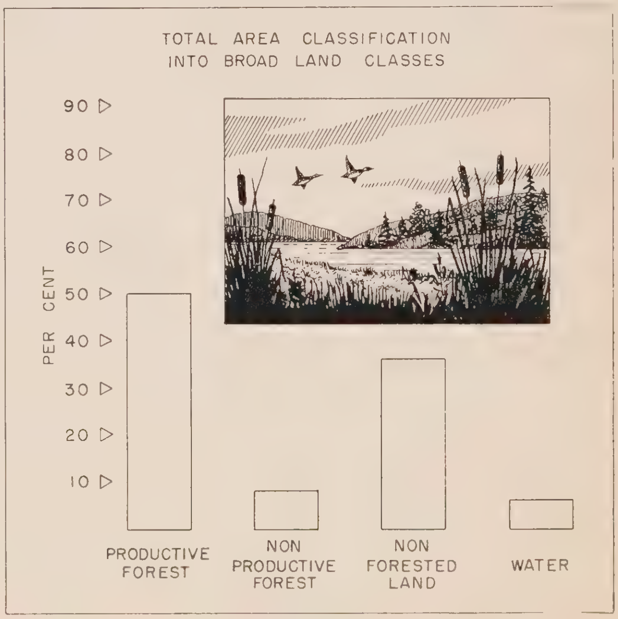


FIGURE 1

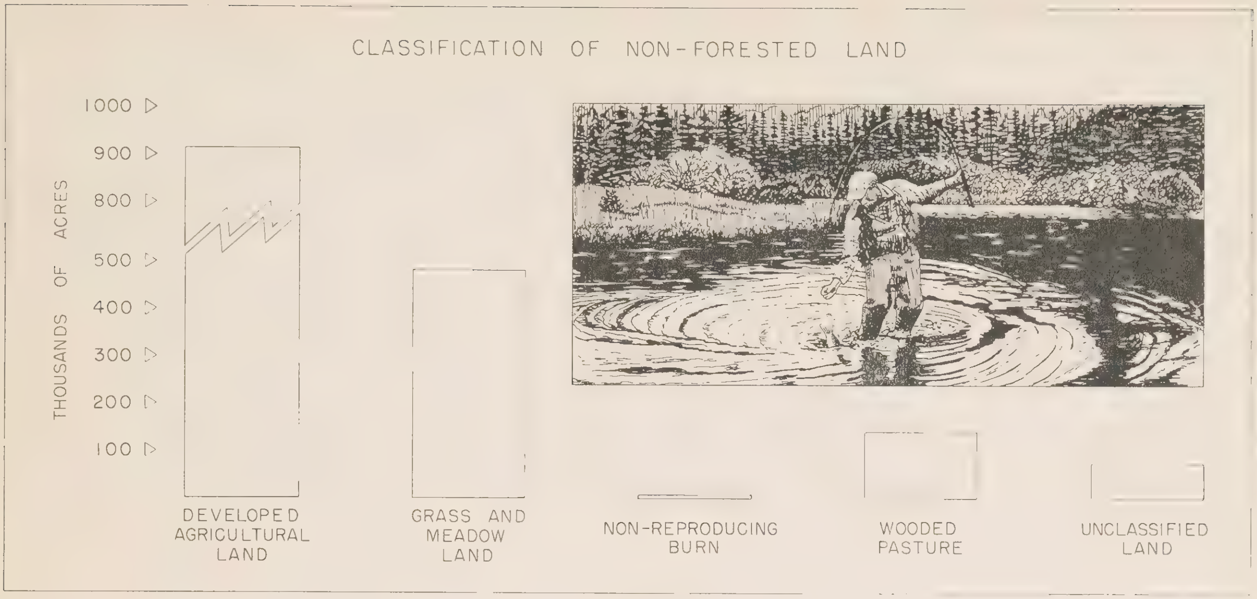


FIGURE 2

towns, villages, roads, railroads, power lines, gravelpits or otherwise withdrawn from forest production.

An analysis of the principal land classifications by townships and counties shows a great variation in the occurrence of productive forest land (table 2). This ranges from slightly below 14 per cent of the total land area in Prince Edward County to just over 71 per cent in Lanark County. For the remaining counties within the district, productive forest land forms from 43 to 69 per cent of the total land area. The distribution of productive forest land by townships ranges from 4 per cent on Amherst Island to 96 per cent in North Canonto Township (fig. 3).

Non-productive forest forms only 2 per cent of the total area of Renfrew County, but over 14 per cent in the counties of Frontenac and Lennox and Addington. Nine townships — Elzevir, Kaladar, Sheffield, Kennebec, Oso, Hinchinbrooke, Bedford, Loughborough and Storrington — contain 195,087 acres of non-productive forest land, just over 58 per cent of the total non-productive forest area within the district.

Agricultural land comprises just over 76 per cent of the land area in Prince Edward County. Of the total land area within this county, developed agricultural land forms 51 per cent, grass and meadows occupy 21 per cent, and wooded pasture 4 per cent. In the remaining counties, agricultural land forms from 23 to 41 per cent of the total land area.

Within the Tweed district, agriculture is concentrated in a narrow area bordering Lake Ontario and, to a lesser degree, along the Ottawa River. Immediately north of this area are nine townships containing a high percentage of non-productive forest land. North of this again is the principal forested area within the district.

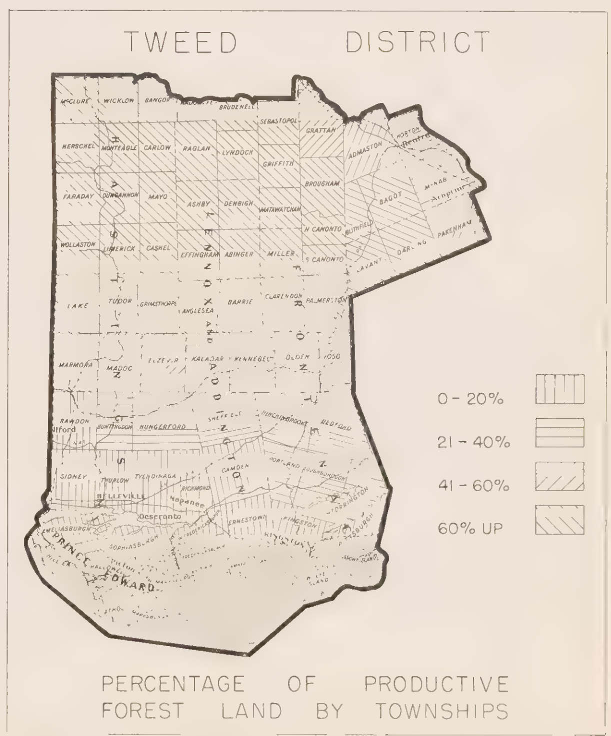


FIGURE 3

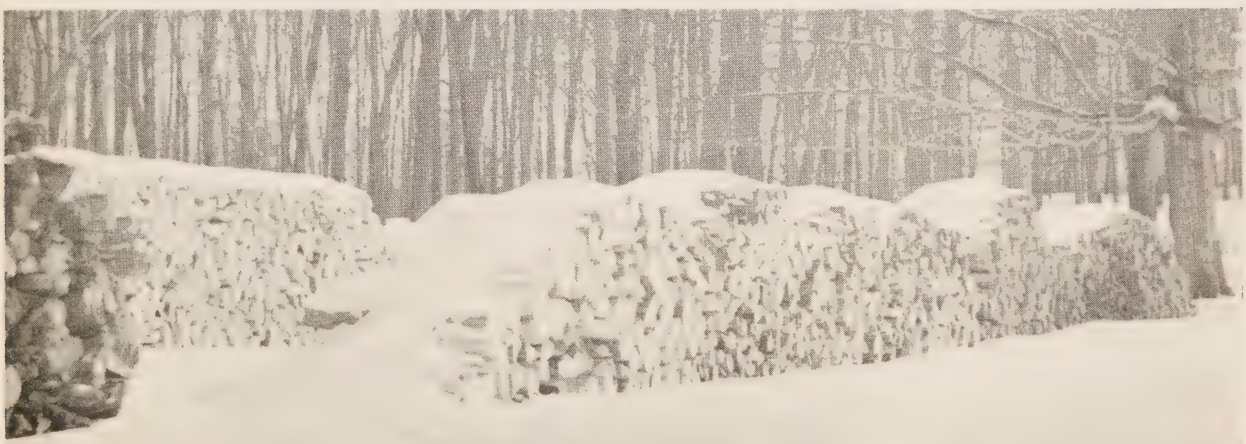
TABLE 2. — *Principal land classifications by townships and counties — Tweed district.*

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture[1]		Other areas[2]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Barrie	64,042	53,488	46,164	86.3	1,954	3.7	2,210	4.1	2,318	4.3	....	....	842	1.6
Bedford	89,950	70,408	22,554	32.1	14,594	20.7	6,572	9.3	14,624	20.8	11,340	16.1	724	1.0
Clarendon	66,234	57,458	45,950	80.0	2,534	4.4	3,612	6.3	4,326	7.5	....	....	1,036	1.8
Hinchinbrooke	75,740	70,756	15,430	21.8	27,753	39.2	5,744	8.1	11,624	16.5	9,405	13.3	800	1.1
Howe Island	6,644	6,628	508	7.7	266	4.0	3,856	58.2	1,526	23.0	356	5.4	116	1.7
Kennebec	77,414	73,340	22,346	30.5	27,270	37.2	2,774	3.8	9,310	12.7	3,924	5.3	7,716	10.5
Kingston	58,030	55,980	4,820	8.6	2,626	4.7	18,590	33.2	19,756	35.3	3,330	5.9	6,858	12.3
Loughborough	62,376	54,538	15,678	28.8	12,284	22.5	10,454	19.2	9,824	18.0	5,412	9.9	886	1.6
Miller	57,068	49,768	46,264	93.0	1,440	2.9	1,504	3.0	264	0.5	....	....	296	0.6
North Canonto	35,206	32,136	30,722	95.6	908	2.8	140	0.5	256	0.8	....	....	110	0.3
Olden	72,030	66,272	38,720	58.4	6,890	10.4	3,768	5.7	11,916	18.0	4,364	6.6	614	0.9
Oso	50,308	46,294	16,078	34.7	10,802	23.3	3,284	7.1	9,868	21.3	5,452	11.8	810	1.8
Palmerston	69,402	62,412	52,488	84.1	1,750	2.8	3,302	5.3	3,850	6.2	2	....	1,020	1.6
Pittsburgh	50,944	48,056	3,296	6.8	2,502	5.2	24,262	50.5	11,236	23.4	4,036	8.4	2,724	5.7
Portland	56,110	53,954	12,216	22.6	3,542	6.6	16,038	29.7	14,766	27.4	6,214	11.5	1,178	2.2
South Canonto	36,320	33,212	30,140	90.7	1,600	4.8	298	0.9	850	2.6	....	....	324	1.0
Storrington	69,730	56,746	12,138	21.4	10,946	19.3	16,774	29.5	10,370	18.3	5,668	10.0	850	1.5
Wolfe Island	28,416	28,386	1,316	4.6	780	2.7	22,702	80.0	1,944	6.9	804	2.8	840	3.0
FRONTENAC COUNTY	1,025,964	919,832	416,828	45.3	130,441	14.2	145,884	15.8	138,628	15.1	60,307	6.6	27,744	3.0
Bangor	41,172	36,274	30,946	85.3	560	1.5	3,026	8.4	1,434	4.0	....	....	308	0.8
Carlow	48,718	46,358	35,904	77.4	1,244	2.7	8,014	17.3	838	1.8	....	....	358	0.8
Cashel	49,948	47,796	43,490	91.0	2,576	5.4	1,098	2.3	528	1.1	....	....	104	0.2
Dungannon	53,072	52,118	40,288	77.3	1,384	2.7	7,784	14.9	2,140	4.1	....	....	522	1.0
Elzevir	70,958	70,188	36,318	51.8	18,056	25.7	4,242	6.0	7,072	10.1	3,668	5.2	832	1.2
Faraday	62,682	58,996	47,250	80.1	1,734	2.9	6,426	10.9	2,862	4.9	....	....	724	1.2
Grimsthorpe	68,978	66,648	60,004	90.0	6,016	9.0	8	....	168	0.3	....	....	452	0.7
Herschel	58,794	51,628	42,818	82.9	1,536	3.0	5,522	10.7	1,448	2.8	....	....	304	0.6
Hungerford	101,524	99,045	25,513	25.8	10,002	10.1	21,806	22.0	28,549	28.8	11,011	11.1	2,164	2.2
Huntingdon	57,246	54,798	16,032	29.3	1,508	2.7	16,038	29.3	15,286	27.9	4,670	8.5	1,264	2.3
Lake	73,896	70,174	64,920	92.5	2,740	3.9	792	1.1	1,316	1.9	....	....	406	0.6
Limerick	55,056	50,898	43,438	85.3	2,362	4.6	2,124	4.2	2,520	5.0	....	....	454	0.9
Madoc	70,736	70,246	28,742	40.9	1,718	2.5	23,966	34.1	11,262	16.0	3,216	4.6	1,342	1.9
Marmora	71,708	68,586	43,002	62.7	2,940	4.3	12,378	18.0	5,880	8.6	2,404	3.5	1,982	2.9
Mayo	51,872	49,678	41,690	83.9	1,470	3.0	4,882	9.8	1,250	2.5	....	....	386	0.8
Monteagle	53,194	52,352	34,830	66.6	1,686	3.2	13,558	25.9	1,898	3.6	....	....	380	0.7
McClure	53,602	51,230	46,294	90.3	1,962	3.8	1,414	2.8	1,212	2.4	....	....	348	0.7
Rawdon	70,340	70,102	12,586	17.9	1,286	1.8	33,772	48.2	15,542	22.2	5,442	7.8	1,474	2.1
Sidney	74,964	72,562	12,163	16.8	2,112	2.9	38,346	52.8	10,152	14.0	3,609	5.0	6,180	8.5
Thurlow	57,632	56,960	7,566	13.3	1,984	3.5	30,482	53.5	9,752	17.1	2,486	4.4	4,690	8.2
Tudor	62,476	61,024	52,562	86.2	1,968	3.2	2,632	4.3	3,054	5.0	....	....	808	1.3
Tyendinaga	93,700	93,518	11,478	12.3	1,370	1.5	33,140	35.4	22,972	24.5	5,114	5.5	19,444	20.8
Wicklow	48,402	46,226	39,386	85.2	1,316	2.8	3,354	7.3	1,796	3.9	....	....	374	0.8
Wollaston	56,232	54,130	43,080	79.6	1,340	2.5	5,904	10.9	3,180	5.9	....	....	626	1.1
HASTINGS COUNTY	1,506,902	1,451,535	860,300	59.3	70,870	4.9	280,708	19.3	152,111	10.5	41,620	2.9	45,926	3.1
Darling	66,056	61,588	48,140	78.1	2,844	4.6	8,048	13.1	1,576	2.6	....	....	980	1.6
Lavant	58,814	56,438	49,974	88.5	1,366	2.4	2,854	5.1	1,002	1.8	....	....	1,242	2.2
Pakenham	65,272	64,126	31,596	49.3	1,930	3.0	26,466	41.3	2,730	4.2	234	0.4	1,170	1.8
LANARK COUNTY	190,142	182,152	129,710	71.2	6,140	3.4	37,368	20.5	5,308	2.9	234	0.1	3,392	1.9
Abinger	55,674	51,814	46,530	89.8	2,652	5.1	942	1.8	1,242	2.4	....	....	448	0.9
Adolphustown	12,098	12,098	2,118	17.5	178	1.5	6,798	56.2	2,216	18.3	542	4.5	246	2.0
Amherst Island	15,018	14,958	626	4.2	732	4.9	11,692	78.1	1,186	7.9	368	2.5	354	2.4
Anglesea	58,104	53,212	45,926	86.3	5,330	10.0	544	1.0	756	1.4	....	....	656	1.3
Ashby	55,142	48,282	45,602	94.4	1,644	3.4	604	1.3	340	0.7	....	....	92	0.2
Camden	93,336	89,836	12,734	14.2	4,436	4.9	31,010	34.5	33,116	36.9	6,542	7.3	1,998	2.2
Denbigh	55,870	54,452	45,566	83.7	1,012	1.8	5,384	9.9	1,858	3.4	....	....	632	1.2
Effingham	55,848	50,688	46,702	92.1	3,274	6.5	188	0.4	150	0.3	....	....	374	0.7

TABLE 2 — (*Cont'd*)

Township and county	Total area	Total land area	Forested land — Productive		Forested land — Non-productive		Agricultural land — Developed agricultural land		Agricultural land — Grass and meadow		Agricultural land — Wooded pasture[1]		Other areas[2]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Ernestown	65,816	65,402	5,676	8.7	602	0.9	31,786	48.6	21,072	32.2	4,428	6.8	1,838	2.8
Kaladar	70,930	69,920	20,077	28.7	38,152	54.6	2,484	3.5	4,308	6.2	3,935	5.6	964	1.4
North Fredericksburgh	27,358	26,008	1,960	7.5	1,162	4.5	12,588	48.4	7,744	29.8	1,846	7.1	708	2.7
Richmond	52,006	51,430	5,994	11.6	2,182	4.2	21,588	42.0	17,058	33.2	2,830	5.5	1,778	3.5
Sheffield	88,888	84,692	18,550	21.9	35,230	41.6	12,332	14.6	12,570	14.8	5,264	6.2	746	0.9
South Fredericksburgh	25,446	22,776	1,682	7.4	1,162	5.1	14,116	62.0	4,440	19.5	1,012	4.4	364	1.6
LENNOX & ADDINGTON COUNTY	731,534	695,568	299,743	43.1	97,748	14.1	152,056	21.9	108,056	15.5	26,767	3.8	11,198	1.6
Ameliasburgh	49,046	47,596	6,550	13.8	4,124	8.7	25,634	53.9	6,880	14.4	3,014	6.3	1,394	2.9
Athol	27,258	24,548	2,918	11.9	950	3.9	10,906	44.4	6,162	25.1	540	2.2	3,072	12.5
Hallowel	53,692	49,098	7,408	15.1	2,420	4.9	28,118	57.3	6,148	12.5	1,580	3.2	3,424	7.0
Hillier	36,706	34,406	3,982	11.6	1,884	5.5	23,172	67.3	3,286	9.6	938	2.7	1,144	3.3
North Marysburgh	23,812	23,590	3,398	14.4	386	1.6	10,024	42.5	8,110	34.4	1,332	5.7	340	1.4
Sophiasburgh	48,438	47,872	7,830	16.4	2,098	4.4	21,704	45.3	12,066	25.2	2,970	6.2	1,204	2.5
South Marysburgh	26,226	26,170	2,876	11.0	1,128	4.3	8,792	33.6	10,754	41.1	970	3.7	1,650	6.3
PRINCE EDWARD COUNTY	265,178	253,280	34,962	13.8	12,990	5.1	128,350	50.7	53,406	21.1	11,344	4.5	12,228	4.8
Admaston	78,732	77,910	36,597	47.0	966	1.2	35,246	45.2	3,854	5.0	....	....	1,247	1.6
Bagot	75,866	69,788	53,670	76.9	3,568	5.1	9,850	14.1	1,714	2.5	....	....	986	1.4
Blithfield	36,496	32,980	30,354	92.0	866	2.6	916	2.8	458	1.4	....	....	386	1.2
Brougham	69,806	66,880	57,832	86.5	854	1.3	5,482	8.2	2,222	3.3	....	....	490	0.7
Brudenell	27,406	26,026	20,856	80.1	514	2.0	2,682	10.3	1,810	7.0	....	....	164	0.6
Grattan	72,117	70,159	41,872	59.7	1,533	2.2	21,241	30.3	4,506	6.4	....	....	1,007	1.4
Griffith	48,672	46,956	42,294	90.1	1,134	2.4	2,040	4.3	1,302	2.8	....	....	186	0.4
Horton	46,815	46,346	16,156	34.8	634	1.4	27,728	59.8	182	0.4	....	....	1,646	3.6
Lyndoch	55,752	53,936	45,704	84.7	1,210	2.2	4,670	8.7	1,948	3.6	....	....	404	0.8
Matawatchan	46,864	44,998	38,634	85.9	774	1.7	4,132	9.2	1,122	2.5	....	....	336	0.7
McNab	74,830	68,118	25,955	38.1	778	1.1	37,071	54.4	1,012	1.5	....	....	3,302	4.9
Radcliffe	13,150	11,980	9,474	79.1	240	2.0	1,536	12.8	564	4.7	....	....	166	1.4
Raglan	69,468	64,782	50,728	78.3	1,580	2.5	9,100	14.0	2,574	4.0	....	....	800	1.2
Sebastopol	48,848	43,558	32,238	74.0	590	1.4	7,558	17.3	2,746	6.3	....	....	426	1.0
RENFREW COUNTY	764,822	724,417	502,364	69.3	15,241	2.1	169,252	23.4	26,014	3.6	....	....	11,546	1.6
TOTAL — TWEED DISTRICT	4,484,542[3]	4,226,784[3]	2,243,907	53.1	333,430	7.9	913,618	21.6	483,523	11.4	140,272	3.3	112,034[3]	2.7

[1] This classification was used only for that portion of the district covered by mosaics. See figure 19.
[2] Other areas include all land administered by the Federal Government, as well as roads, railroads, cities, towns, villages, gravel-pits, etc.
[3] These totals include land areas administered by the Federal Government.



Low quality trees may be utilized as fuelwood.

Forest Land Ownership

In Ontario, forest lands have generally been retained under public ownership, and the right to cut and remove timber from them has been granted by a licence. Lands suitable for agriculture have been opened for settlement, and lands have been granted or sold under the various land settlement regulations which have been in force from time to time. Lands are also patented for mining purposes, summer resorts, and other uses. All of these various types of ownership are grouped under "patented lands," which include all lands owned privately, in contrast to Crown lands.

It has been the usual practice in this province to reserve all pine timber to the Crown at the time patent is issued, while on some lands patented for mining all timber is reserved to the Crown. The ownership of timber on privately owned lands presents an exceedingly complicated subject, and in establishing an ownership classification for inventory no attempt has been made to segregate these various groups. All recorded patented land is treated as such, whether or not timber rights are vested in the Crown.

Crown lands occupy an area of 1,357,094 acres, excluding water, and patented lands cover 3,099,576 acres or 30 and 70 per cent of the total land area respectively. If, however, only productive forest land is considered, 43 per cent of this area is Crown land and 57 per cent is patented (fig. 4). Patented

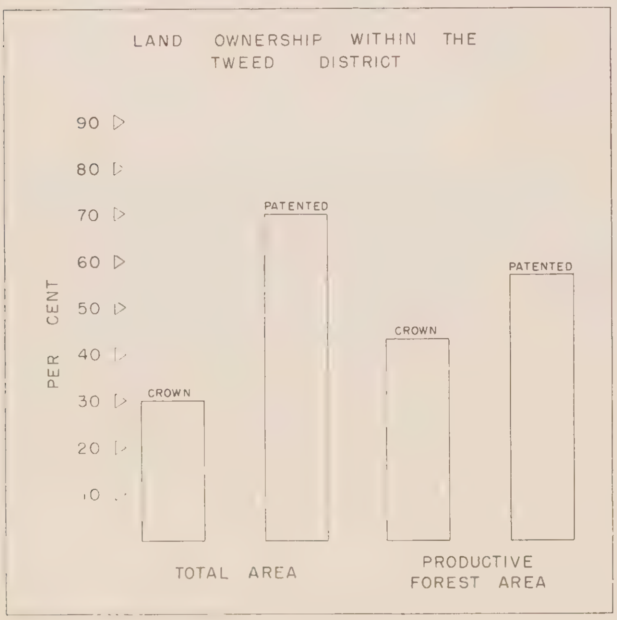


FIGURE 4

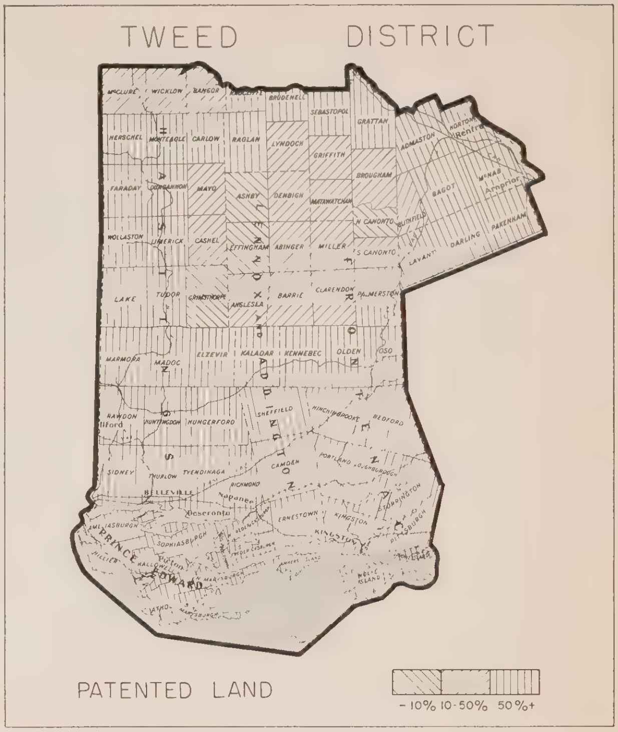


FIGURE 5

land is further classified on a township basis into townships containing less than 10 per cent patented land; those containing between 10 and 50 per cent patented land, and townships over 50 per cent patented land (fig. 5).

Under the terms of legislation of what is now known as The Tree Act (R.S.O. 1950), any municipality may purchase land and either place the responsibility of reforestation and management in the hands of the Provincial Government through co-operative agreements, or carry out the planting and management of the forest without an agreement. Areas for which an agreement has been signed with the Minister of Lands and Forests are, for the purposes of this report, included with Crown lands.

The agreement provides that the Provincial Government will assume the responsibility for re-establishment and care of the forest for a stated period of years (usually fifty in recent agreements). At the end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price.

Similar agreements cover the development of lands purchased by River Valley Conservation Authorities. There are two of these Authority Forests in the Tweed district: the Moira, containing 3,699 acres, and the Napanee, comprising 2,327 acres.

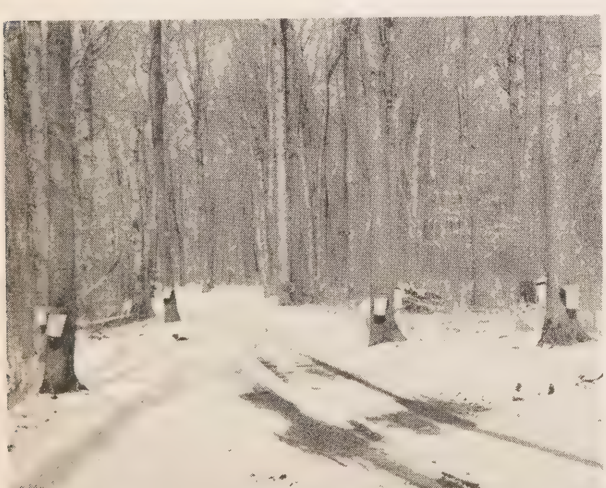
In addition, the Lennox and Addington County Forest covers 786 acres; Prince Edward County contains the Sand Banks Forest of 560 acres. This is a Crown Property Forest, whose primary function is to stabilize sand dunes and prevent their spread in a southeasterly direction on to agricultural lands.

Age Classes

For sustained timber yields, a forest should be made up of trees of all age classes and stages of development from seedlings to mature timber, in such proportions that when one group of trees is harvested, another is ready to take its place. The present forests of the Tweed district do not meet this requirement.

Of the total productive forest area, 115,223 acres, or 5 per cent, is mature; 1,902,288 acres, or 85 per cent, is immature; 79,998 acres, or 4 per cent, is classed as all-aged; 139,425 acres, or 6 per cent, is young growth; and 6,973 acres, less than one per cent, is reproducing forest (table 3, fig. 6).

Crown land, totalling 959,352 acres, shows a similar distribution with 5 per cent mature, 89 per cent immature, 6 per cent young growth, and less than one per cent occupied by all-aged forest and reproducing forest. Patented land, which totals 1,284,555 acres, has 5 per cent mature, 82 per cent immature, 6 per cent all-aged, 7 per cent young growth and under one per cent of reproducing forest.



A "sugar" bush in production.

Maple syrup evaporating house.

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	910	3,234	4,144	*
Hardwood	37,575	49,949	87,524	4
Mixedwoods	9,554	14,001	23,555	1
TOTAL	48,039	67,184	115,223	5
Immature forest:				
Coniferous	22,435	64,291	86,726	4
Hardwood	413,073	538,405	951,478	42
Mixedwoods	413,409	450,675	864,084	39
TOTAL	848,917	1,053,371	1,902,288	85
All-aged forest:				
Hardwood	1,616	52,178	53,794	3
Mixedwoods	1,452	24,752	26,204	1
TOTAL	3,068	76,930	79,998	4
Young growth:				
Coniferous	1,052	3,244	4,296	*
Hardwood	36,470	59,891	96,361	4
Mixedwoods	18,613	20,155	38,768	2
TOTAL	56,135	83,290	139,425	6
Reproducing forest	3,193	3,780	6,973	
TOTAL PRODUCTIVE FOREST	959,352	1,284,555	2,243,907	100

* Less than one per cent.

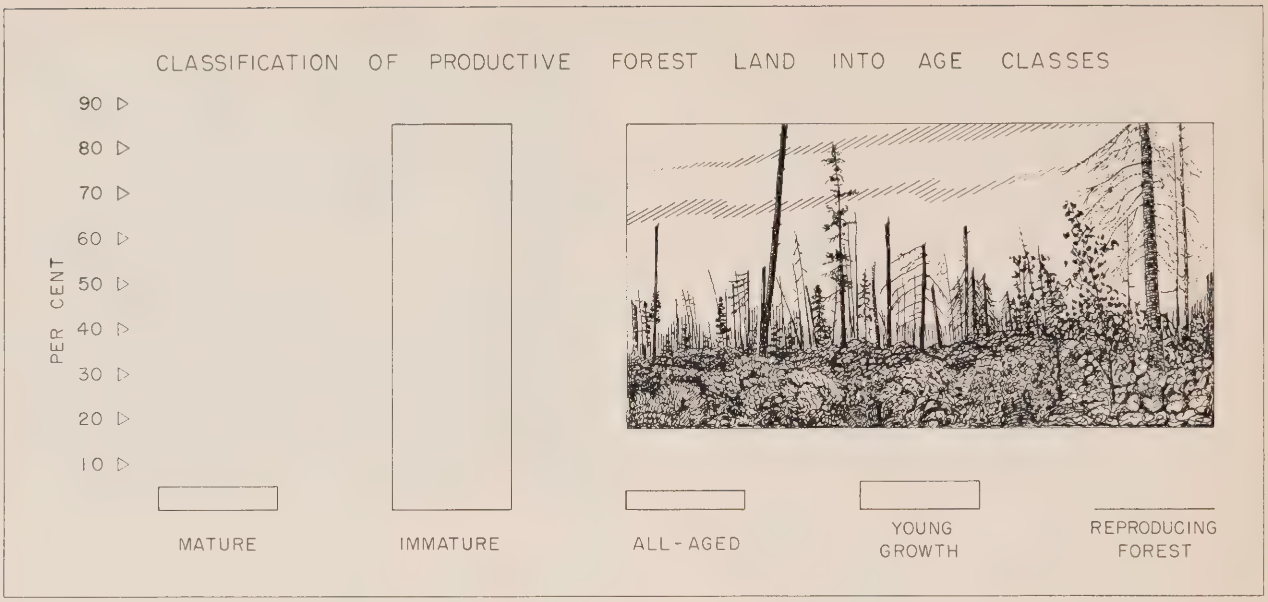


FIGURE 6

Regional Forest Types

The forests of the Tweed district lie within the Great Lakes-St. Lawrence Forest Region. During glacial times this forest was intruded by Boreal species. Major climatic phases, logging and fire have favoured further Boreal and Deciduous intrusions. Sugar maple and yellow birch are characteristic species of this region. White pine and red maple are widely distributed, while hemlock and beech have a more restricted distribution.

Within the district are two forest sections (fig. 7), as follows:

1. The Algonquin section, covering the northern part of the district, forms 73 per cent of the total area.
2. The Huron section forms 27 per cent of the district and is adjacent to Lake Ontario.

The bedrock of the Algonquin section is formed by crystalline limestones, schists and gneisses of the Precambrian Shield. These are covered by light-textured glacial deposits of a varied character. The topography is rough and irregular and abounds in lakes. Sugar maple, yellow birch, hemlock and white pine form the characteristic association of this region. Second growth stands, in which aspen, white birch, balsam fir, white spruce, white and red pine, soft maple and ironwood are common components, have largely replaced the original forest.

The Huron section is underlain by Ordovician bedrock of the Trenton-Black River group. This is composed primarily of limestone, but sandstone, dolomite, and shale also occur. These bedrocks are overlain by glacial material and are modified, in part, by wave action and lacustrine deposits. Throughout this section deciduous stands are prevalent, with sugar maple and beech the dominant association. Hemlock, balsam fir and white pine have a scattered representation, while elm, ash, and

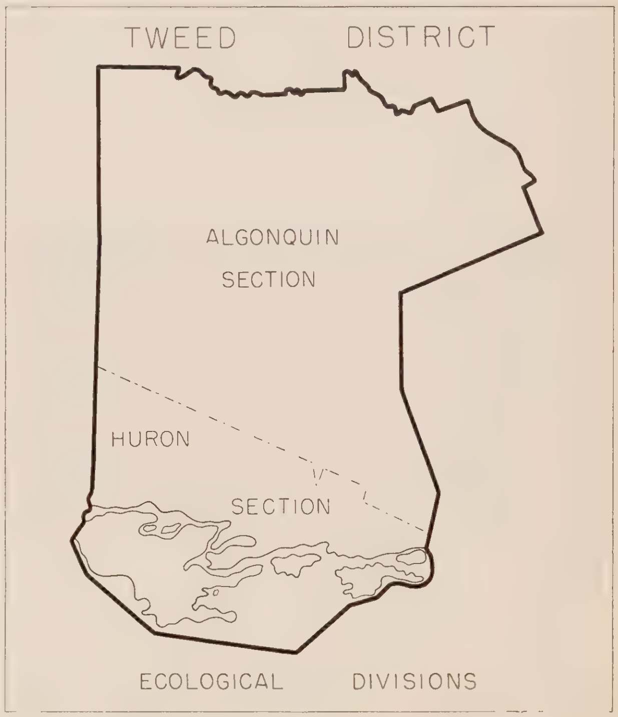


FIGURE 7

silver maple occur on specialized sites. This section has been divided into minor physiographic regions[1] as follows (fig. 8):

1. *Peterborough Drumlin Field* — For the most part this is underlain by Trenton limestone which is highly fossiliferous and easily disintegrated. The drumlins are composed of highly calcareous till and, in Hastings County, contain Precambrian boulders 2 to 3 feet in diameter, called "hardheads." This drumlin field is notable for its eskers which are a valuable source of road gravel. Utilization of drumlinized areas is handicapped by stoniness, steep slopes, and wet, swampy hollows.

2. *Dummer Moraines* — The sedimentary limestones formed a rough, stony plain bordering the Precambrian Shield and sloping gently to the south. Angular fragments of limestone and Precambrian rocks are characteristic of this area. Despite the limitations of stoniness and drought, a large proportion of this area has been cleared for agriculture.

3. *Napanee Plain* — This is a flat to undulating limestone plain from which glaciers stripped most of the overburden. Agriculture is mainly devoted to summer dairying for cheese production. Old pastures are being invaded by white cedar, which occurs in fairly pure stands on the dry, shallow soil.

4. *Prince Edward Peninsula* — The entire peninsula, except for one small hill of Precambrian granite near Ameliasburgh, is underlain by Trenton limestone. Soil depth varies, but more than half of the peninsula has shallow soils. The western and southern shores are low, while the eastern and northern shores are often precipitous rocky bluffs. The entire shoreline is irregular, because of long bays and inlets.

5. *Iroquois Plain* — In late Pleistocene times the lowland bordering Lake Ontario was inundated. This old lake bottom, varying in width from a few hundred yards to some eight miles, now forms the Iroquois Plain. Owing to varied conditions, this has been divided into sub-sections. The most eastern of these — the Trent embayment — occurs in the Tweed district. Much of this area consists of drumlin hills crowned by boulder pavements. A variety of lacustrine deposits are found in the lowlands. The characteristic landscape is a "drumlin and clay flat" pattern.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951.

FIGURE 8

6. *Leeds Knobs and Flats* — Relatively bare rock-knobs interspersed with a grey to drab, weakly calcareous clay are a typical feature of this area. The clay channels between the rock outcrops form one of the best agricultural soils in Eastern Ontario.

7. *Ottawa Valley Clay Plain* — This area, lying within the Algonquin section, parallels the Ottawa River in the north-east corner of the district. In Renfrew County the acid clay loam has highly leached surface horizons, but is, nevertheless, a productive and durable soil.

8. *Smith's Falls Limestone Plain* — The northern tip of this plain enters the Tweed district. It is an area of shallow soil over limestone, and is generally level. Soils vary in texture, and stoniness is common.

Cover Types

The forests of the Tweed district contain 27 native tree species. Plantations within the district contain, in addition, Scots pine, Carolina poplar, black locust and European larch. Ten species contain 80 per cent of the total wood volume: sugar maple 19 per cent, poplar 15 per cent, white pine 9 per cent, elm and white cedar 7 per cent each, white birch 6 per cent, balsam fir 5 per cent, red oak, soft maple and yellow birch 4 per cent each.

The forests of the district are described under three main cover types: coniferous, hardwood and

mixedwoods. The coniferous type is one in which 75 per cent or more of the number of trees are conifers or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there are areas of natural and artificially established reproduction which have not yet attained a sufficiently stable composition to be classified into cover types.

The hardwood type occupies 53 per cent of the productive forest land within the district (table 4); the mixedwoods type covers 43 per cent of the area, and the coniferous type only 4 per cent (fig. 9).

TABLE 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	910	*	3,234	*	4,144	*
Immature	22,435	3	64,291	5	86,726	4
Young growth	1,052	*	3,244	*	4,296	*
TOTAL	24,397	3	70,769	5	95,166	4
Hardwood type:						
Mature	37,575	4	49,949	4	87,524	4
Immature	413,073	43	538,405	42	951,478	43
All-aged	1,616	*	52,178	4	53,794	2
Young growth	36,470	4	59,891	5	96,361	4
TOTAL	488,734	51	700,423	55	1,189,157	53
Mixedwoods type:						
Mature	9,554	1	14,001	1	23,555	1
Immature	413,409	43	450,675	35	864,084	39
All-aged	1,452	*	24,752	2	26,204	1
Young growth	18,613	2	20,155	2	38,768	2
TOTAL	443,028	46	509,583	40	952,611	43
Reproducing forest	3,193	*	3,780	*	6,973	*
TOTAL PRODUCTIVE FOREST	959,352	100	1,284,555	100	2,243,907	100

* Less than one per cent.

When Crown and patented land are considered separately, the same general cover type distribution occurs. On Crown land, the hardwood type occupies 51 per cent, the mixedwoods type 46 per cent and the coniferous type 3 per cent. Patented lands have 55 per cent of the area covered by the hardwood type, 40 per cent by mixedwoods and 5 per cent by

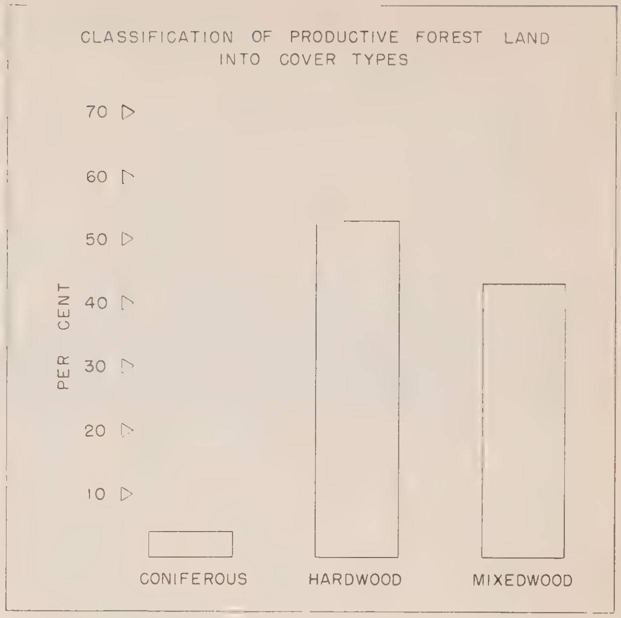


FIGURE 9

the coniferous type. Reproducing forest accounts for less than one per cent of the productive forest area in all categories of land ownership.

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

The volume of the primary growing stock on productive forest lands in the Tweed district is just over three billion cubic feet (3,213,018,000 cubic feet). This is an average of 1,432 cubic feet per acre (table 5). The mature age class contains 293.7 million cubic feet (table 6), or 2,549 cubic feet per acre, while the immature age class contains 2.8

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average Total
	4″-9″ d.b.h.	10″ up d.b.h.	Average Total	4″-9″ d.b.h.	10″ up d.b.h.	Average Total	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	568	2,114	2,682	507	1,946	2,453	2,549
Immature	755	713	1,468	783	695	1,478	1,474
All-aged	605	979	1,584	538	906	1,444	1,449
Productive forest	698	740	1,438	701	726	1,427	1,432

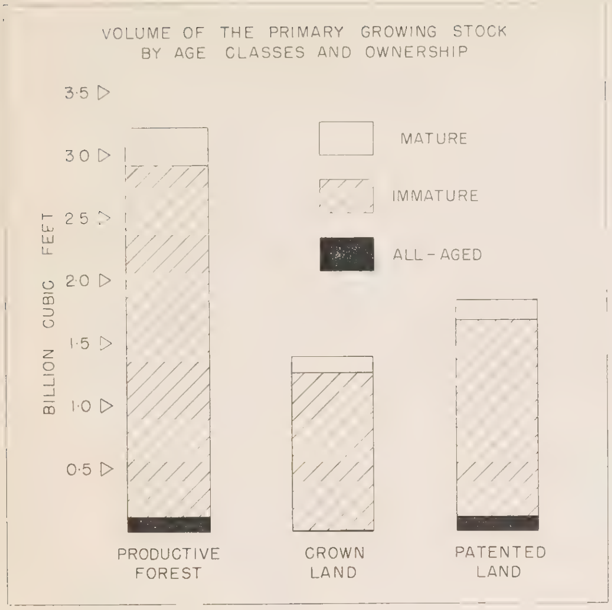


FIGURE 10

billion cubic feet, or 1,474 cubic feet per acre. In addition, the stands classified as all-aged contain 115.9 million cubic feet, or 1,449 cubic feet per acre of mature and immature timber.

Crown lands in the Tweed district contain 1.4 billion cubic feet (table 7), or an average of 1,438 cubic feet per acre. The mature age class contains 128.9 million cubic feet, or 2,682 cubic feet per acre; the immature, 1.2 billion cubic feet, or 1,468 cubic feet per acre; and the all-aged stands, 4.9 million cubic feet, or 1,584 cubic feet per acre.

The volume of the primary growing stock on patented land in the Tweed district is just over 1.8 billion cubic feet (table 8, fig. 10), or an average of 1,427 cubic feet per acre. The mature age class contains 164.8 million cubic feet, or 2,453 cubic feet per acre; the immature, 1.6 billion cubic feet, or 1,478 cubic feet per acre; and the all-aged, 111.1 million cubic feet, or 1,444 cubic feet per acre.

Conifers vs. Hardwoods

Productive forest lands in the Tweed district contain mainly hardwoods or broadleaved species. The volume of hardwoods is nearly 2.3 billion cubic feet, or 71 per cent of the growing stock, while conifers total 924 million cubic feet, or 29 per cent of the primary growing stock (table 9).

The 1.4 billion cubic feet of timber on Crown lands is distributed between hardwoods and conifers in the same proportion as for productive forest lands (table 10). Conifers, totalling 404 million cubic feet, comprise 15 per cent of the mature volume, 31 per cent of the immature, and 19 per cent of the volume in the all-aged stands. Hardwoods, which total 976 million cubic feet, form 85 per cent of the mature volume, 69 per cent of the immature, and 81 per cent of the volume in the all-aged stands.

On patented lands, the volume of hardwoods is 1.3 billion cubic feet, or 72 per cent of the total volume; while the volume of conifers is 520 million cubic feet, or 28 per cent of the total volume (table 11). In the mature and all-aged stands, 15 per cent

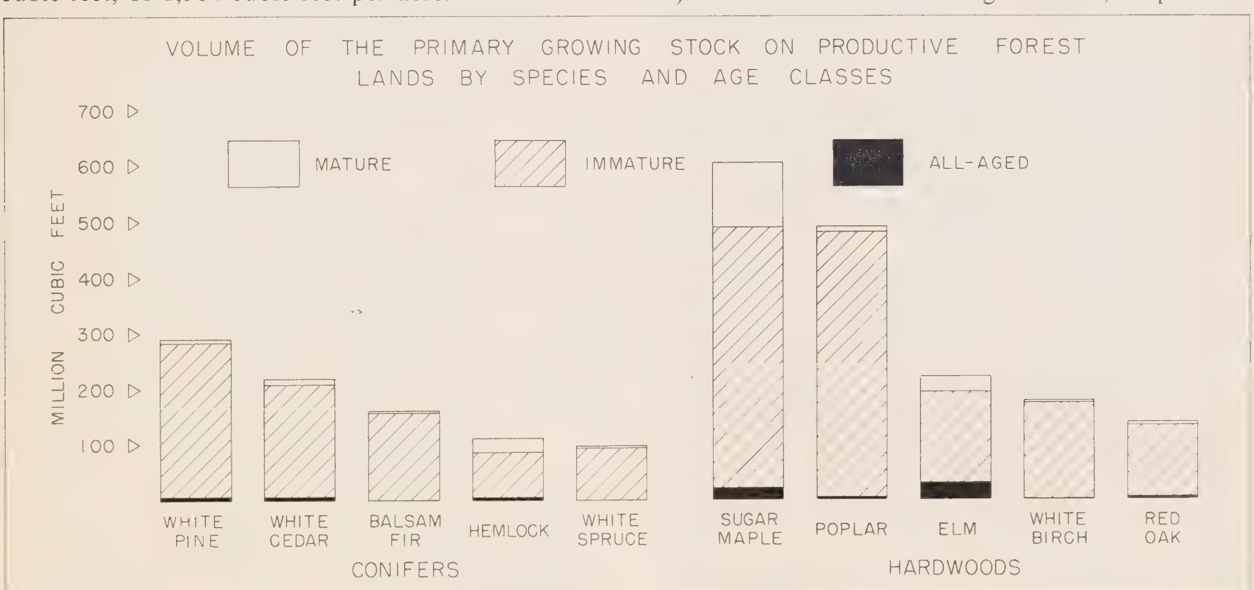
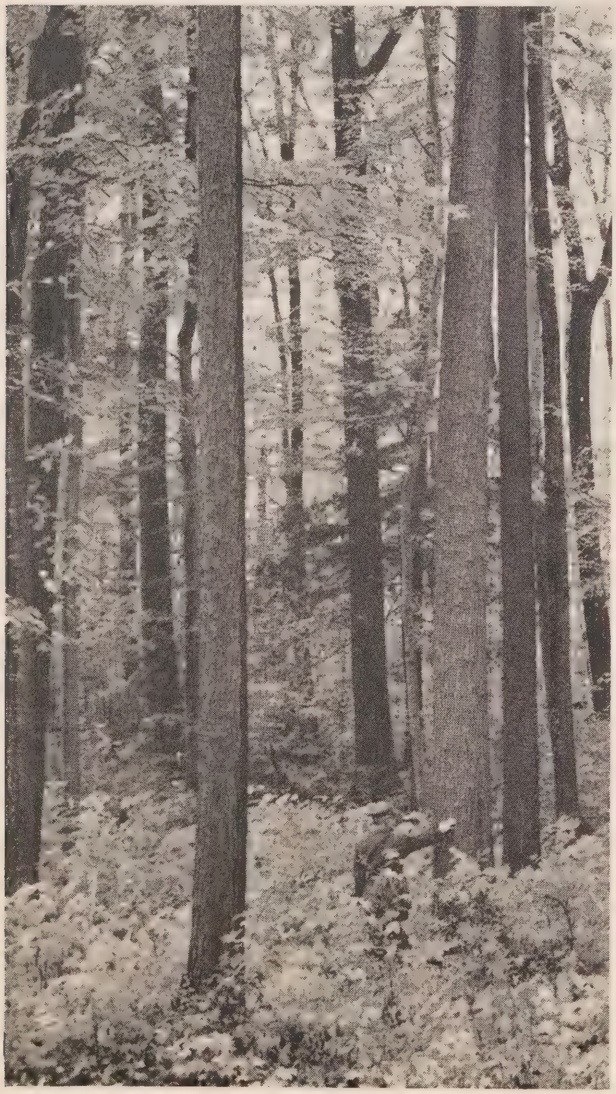


FIGURE 11

of the volume is coniferous and 85 per cent hardwood. Conifers comprise 31 per cent of the volume in immature stands, and hardwoods 69 per cent.

White pine and white cedar are the principal conifers, comprising 55 per cent of the coniferous volume within the district (fig. 11). Of the eleven coniferous species recorded in the inventory, five — white pine, white cedar, balsam fir, hemlock and white spruce — contain 95 per cent of the coniferous volume. In the hardwood group, sugar maple and poplar account for 48 per cent of the total hardwood volume. The hardwood group, which contains 16 species, has 71 per cent of the volume in five species: sugar maple, poplar, elm, white birch and red oak.



Woodlots can produce valuable timber.

TABLE 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Tweed district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	3,344	4,960	93,494	78,222	....	....	180,020
Hardwood	44,074	177,019	672,888	563,055	27,431	47,611	1,532,078
Mixedwoods	13,938	50,339	699,549	696,188	15,849	25,057	1,500,920
TOTAL	61,356	232,318	1,465,931	1,337,465	43,280	72,668	3,213,018

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	2,960	3,332	79,883	61,160	....	....	147,335
Hardwood	2,036	8,996	32,682	56,036	1,297	2,311	103,358
Mixedwoods	6,444	19,456	305,081	328,142	6,696	7,535	673,354
TOTAL	11,440	31,784	417,646	445,338	7,993	9,846	924,047

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	384	1,628	13,611	17,062	....	....	32,685
Hardwood	42,038	168,023	640,206	507,019	26,134	45,300	1,428,720
Mixedwoods	7,494	30,883	394,468	368,046	9,153	17,522	827,566
TOTAL	49,916	200,534	1,048,285	892,127	35,287	62,822	2,288,971

Table 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Tweed district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	786	1,347	24,200	21,931	....	....	48,264
Hardwood	20,355	77,957	285,072	246,621	958	1,550	632,513
Mixedwoods	6,165	22,261	331,410	336,692	897	1,454	698,879
Total	27,306	101,565	640,682	605,244	1,855	3,004	1,379,656

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	674	719	20,591	17,334	....	....	39,318
Hardwood	998	4,621	14,023	25,480	54	90	45,266
Mixedwoods	2,836	8,948	144,965	161,414	347	456	318,966
Total	4,508	14,288	179,579	204,228	401	546	403,550

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	112	628	3,609	4,597	....	....	8,946
Hardwood	19,357	73,336	271,049	221,141	904	1,460	587,247
Mixedwoods	3,329	13,313	186,445	175,278	550	998	379,913
Total	22,798	87,277	461,103	401,016	1,454	2,458	976,106

Table 8. — *Cubic-foot volumes of primary growing stock on patented land in the Tweed district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	2,558	3,613	69,294	56,291	....	....	131,756
Hardwood	23,719	99,062	387,816	316,434	26,473	46,061	899,565
Mixedwoods	7,773	28,078	368,139	359,496	14,952	23,603	802,041
Total	34,050	130,753	825,249	732,221	41,425	69,664	1,833,362

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	2,286	2,613	59,292	43,826	....	....	108,017
Hardwood	1,038	4,375	18,659	30,556	1,243	2,221	58,092
Mixedwoods	3,608	10,508	160,116	166,728	6,349	7,079	354,388
Total	6,932	17,496	238,067	241,110	7,592	9,300	520,497

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	272	1,000	10,002	12,465	....	....	23,739
Hardwood	22,681	94,687	369,157	285,878	25,230	43,840	841,473
Mixedwoods	4,165	17,570	208,023	192,768	8,603	16,524	447,653
Total	27,118	113,257	587,182	491,111	33,833	60,364	1,312,865

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4 to 9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material, depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller-size material in the top which may be used as pulpwood or for purposes other than saw timber. The quantity in this residual top is relatively small, and is included in the 10 inches and over material in all inventory estimates.

On productive forest lands, 1,571 million cubic feet, or 49 per cent, of the primary growing stock are in the 4 to 9-inch d.b.h. class and 1,642 million cubic feet, or 51 per cent, are in the 10-inch and over d.b.h. class. The hardwoods are evenly distributed between the two size classes, while 47 per cent of the coniferous volume is in the smaller size

TABLE 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Tweed district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	624	5,605	58,455	218,980	1,147	4,417	289,228
Red pine	19	9	8,976	19,293	9	28	28,334
Jack pine	293	77	569	30	....	....	969
Pitch pine	....	....	42	60	17	28	147
White spruce	437	1,212	38,042	57,735	140	337	97,903
Black spruce	312	418	6,181	2,937	7	4	9,859
Balsam fir	2,485	836	128,776	28,222	386	99	160,804
Hemlock	2,899	18,020	30,667	55,494	1,730	2,954	111,764
White cedar	4,175	5,500	140,886	60,794	4,432	1,900	217,687
Red cedar	148	90	507	94	51	30	920
Larch	48	17	4,545	1,699	74	49	6,432
TOTAL CONIFERS	11,440	31,784	417,646	445,338	7,993	9,846	924,047
Sugar maple	21,627	93,741	240,388	229,522	8,024	11,702	605,004
Soft maple	3,110	10,221	73,391	32,224	5,957	9,455	134,358
White birch	1,293	1,991	124,620	48,079	988	747	177,718
Yellow birch	2,966	18,347	36,484	64,440	1,311	1,285	124,833
Beech	5,258	19,717	26,039	41,670	1,229	2,358	96,271
Elm	4,011	23,534	71,311	92,881	8,487	21,368	221,592
Ironwood	2,844	602	42,859	3,736	1,130	95	51,266
Red oak	502	3,821	63,796	65,652	887	3,928	138,586
White oak	138	848	2,584	1,696	946	2,073	8,285
Poplar	2,050	5,656	254,151	224,434	1,414	2,865	490,570
Black ash	2,221	2,754	41,780	20,181	2,265	322	69,523
White ash	1,464	2,916	30,321	16,339	1,017	1,733	53,790
Basswood	1,815	15,429	31,492	48,849	1,007	4,008	102,600
Black cherry	438	390	7,506	1,588	148	140	10,210
Butternut	18	245	292	442	90	308	1,395
Hickory	161	322	1,271	394	387	435	2,970
TOTAL HARDWOODS	49,916	200,534	1,048,285	892,127	35,287	62,822	2,288,971
TOTAL ALL SPECIES	61,356	232,318	1,465,931	1,337,465	43,280	72,668	3,213,018

TABLE 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Tweed district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	195	1,640	26,279	103,049	58	234	131,455
Red pine	14	....	4,003	8,970	....	....	12,987
Jack pine	216	57	110	1	....	....	384
Pitch pine	....	....	7	9	2	4	22
White spruce	227	590	17,438	26,977	6	21	45,259
Black spruce	191	268	2,525	1,254	....	....	4,238
Balsam fir	1,361	454	60,481	13,511	18	5	75,830
Hemlock	1,366	9,338	13,575	25,170	131	196	49,776
White cedar	932	1,941	53,847	24,758	179	83	81,740
Red cedar	....	....	4	1	1	....	6
Larch	6	....	1,310	528	6	3	1,853
TOTAL CONIFERS	4,508	14,288	179,579	204,228	401	546	403,550
Sugar maple	10,776	45,399	106,734	105,896	255	308	269,368
Soft maple	759	908	29,256	12,537	242	350	44,052
White birch	658	999	57,330	22,411	42	31	81,471
Yellow birch	1,484	10,178	16,432	29,485	80	85	57,744
Beech	2,679	9,588	11,346	18,992	42	73	42,720
Elm	828	5,513	25,554	36,740	341	893	69,869
Ironwood	1,390	306	19,302	1,758	53	3	22,812
Red oak	250	1,301	28,944	29,367	45	212	60,119
White oak	4	31	153	125	43	81	437
Poplar	1,129	2,973	118,329	104,718	53	120	227,322
Black ash	1,011	1,559	18,308	9,740	143	21	30,782
White ash	698	1,113	12,730	6,923	50	72	21,586
Basswood	905	7,201	13,376	21,603	45	183	43,313
Black cherry	222	197	3,224	675	4	4	4,326
Butternut	1	5	18	28	4	12	68
Hickory	4	6	67	18	12	10	117
TOTAL HARDWOODS	22,798	87,277	461,103	401,016	1,454	2,458	976,106
TOTAL ALL SPECIES	27,306	101,565	640,682	605,244	1,855	3,004	1,379,656

class and 53 per cent in the larger. When the age classes are considered separately, 79 per cent of the mature volume and 63 per cent of the all-aged volume occurs in the larger size class. The immature age class has 52 per cent of its volume in the 4 to 9-inch group and 48 per cent in the 10-inch and over group (fig. 12).

An analysis of the volume distribution on Crown and patented lands indicates that for the principal species, species groups and age classes the size class relationship is very similar to that on productive forest lands. For this reason, an analysis will be presented for the total growing stock, instead of separately by Crown and patent ownership.

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Tweed district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	429	3,965	32,176	115,931	1,089	4,183	157,773
Red pine	5	9	4,973	10,323	9	28	15,347
Jack pine	77	20	459	29	....	....	585
Pitch pine	....	....	35	51	15	24	125
White spruce	210	622	20,604	30,758	134	316	52,644
Black spruce	121	150	3,656	1,683	7	4	5,621
Balsam fir	1,124	382	68,295	14,711	368	94	84,974
Hemlock	1,533	8,682	17,092	30,324	1,599	2,758	61,988
White cedar	3,243	3,559	87,039	36,036	4,253	1,817	135,947
Red cedar	148	90	503	93	50	30	914
Larch	42	17	3,235	1,171	68	46	4,579
TOTAL CONIFERS	6,932	17,496	238,067	241,110	7,592	9,300	520,497
Sugar maple	10,851	48,342	133,654	123,626	7,769	11,394	335,636
Soft maple	2,351	9,313	44,135	19,687	5,715	9,105	90,306
White birch	635	992	67,290	25,668	946	716	96,247
Yellow birch	1,482	8,169	20,052	34,955	1,231	1,200	67,089
Beech	2,579	10,129	14,693	22,678	1,187	2,285	53,551
Elm	3,183	18,021	45,757	56,141	8,146	20,475	151,723
Ironwood	1,454	296	23,557	1,978	1,077	92	28,454
Red oak	252	2,520	34,852	36,285	842	3,716	78,467
White oak	134	817	2,431	1,571	903	1,992	7,848
Poplar	921	2,683	135,822	119,716	1,361	2,745	263,248
Black ash	1,210	1,195	23,472	10,441	2,122	301	38,741
White ash	766	1,803	17,591	9,416	967	1,661	32,204
Basswood	910	8,228	18,116	27,246	962	3,825	59,287
Black cherry	216	193	4,282	913	144	136	5,884
Butternut	17	240	274	414	86	296	1,327
Hickory	157	316	1,204	376	375	425	2,853
TOTAL HARDWOODS	27,118	113,257	587,182	491,111	33,833	60,364	1,312,865
TOTAL ALL SPECIES	34,050	130,753	825,249	732,221	41,425	69,664	1,833,362

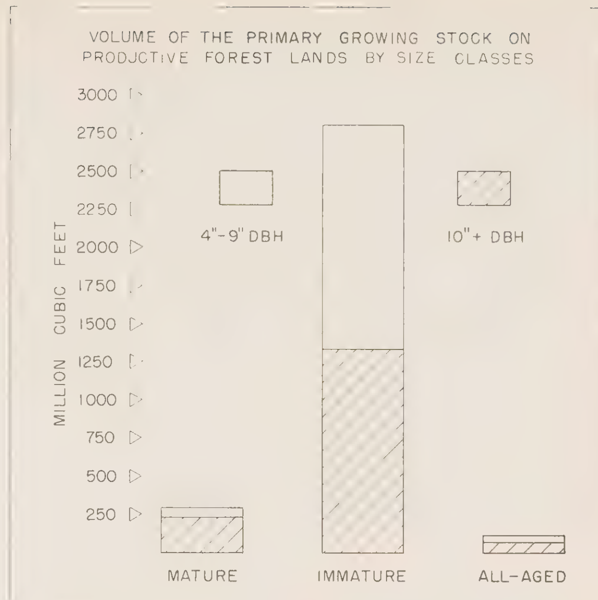


FIGURE 12

The immature age class, comprising 87 per cent of the volume within the district, contains 93 per cent of the coniferous and 85 per cent of the hardwood volume. Within this age class three of the principal conifers produce primarily sawlogs, while two produce mainly cordwood material (fig. 13). White pine has 79 per cent, hemlock 64 per cent and white spruce 60 per cent of the immature volume in the 10-inch and over class. Balsam fir has 82 per cent and white cedar 70 per cent of their volume in the 4 to 9-inch d.b.h. group. The hardwood volume in this age class is more equally distributed between the two size classes, with the 4 to 9-inch class containing 51 per cent of the sugar maple, 53 per cent of the poplar and 72 per cent of the white birch, while the 10-inch and over group contains 57 per cent of the elm and 51 per cent of the red oak. Only four of the remaining hardwoods, yellow birch, beech, basswood and butternut, have the greater proportion of their volume in the sawlog class.

The mature age class contains 9 per cent of the total, 11 per cent of the hardwood and 5 per cent of the conifer volume in the Tweed district. It produces predominantly sawlog material, having 79 per cent of the total, 74 per cent of the conifer and 80 per cent of the hardwood volume in this class. Except for balsam fir, which has 75 per cent of its volume in the pulpwood size class, the principal conifers and hardwoods in this age class are sawlog producers. Of the mature volume by species, the

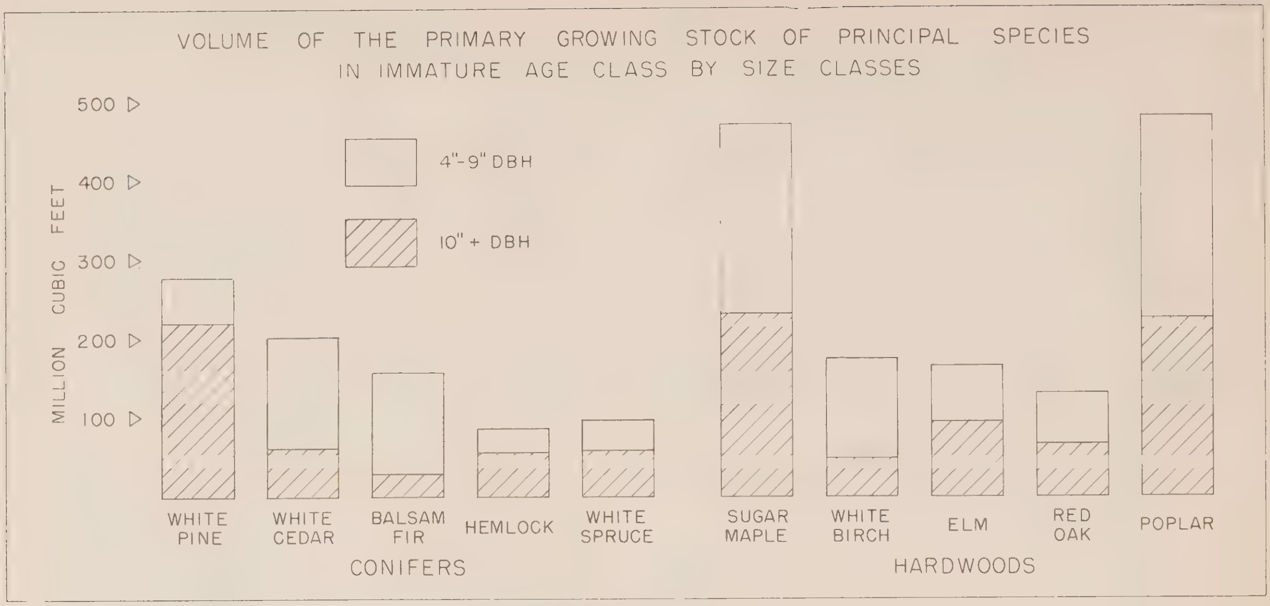


FIGURE 13

10-inch d.b.h. group contains: 90 per cent of the white pine; 73 per cent of the spruce; 86 per cent of the hemlock; 57 per cent of the white cedar; 81 per cent of the sugar maple; 86 per cent of the yellow birch; 79 per cent of the beech; 85 per cent of the elm; and 89 per cent of the basswood (fig. 14).

The all-aged stands contain only 4 per cent of the volume within the district. Two per cent of the coniferous and 4 per cent of the hardwood volume occur within this age class. The principal conifers are white pine, hemlock and white cedar. Of these, white pine has 79 per cent and hemlock 63 per cent in the sawlog size class, while white cedar, with 70 per cent in the smaller size class, produces mainly cordwood material. In general, the hardwood species are primarily producers of sawlogs with 64 per cent of their total volume in this size class. The three principal hardwood species all have the greater part of their volume in the 10-inch d.b.h. group. This group contains 59 per cent of the sugar maple, 61 per cent of the soft maple and 72 per cent of the elm.

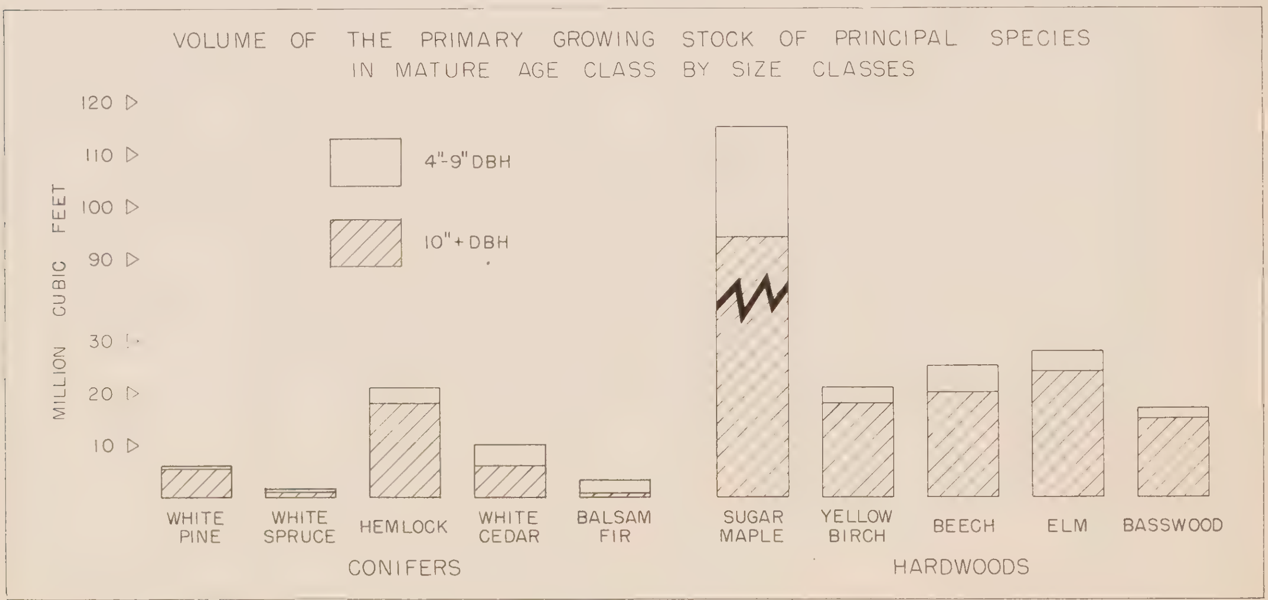


FIGURE 14

Allowable Cut

The calculations of the allowable cut have been carried out for each species by means of a volume formula[1], using an appropriate rotation[2]. The amount of the annual allowable cut results directly from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

Allowable cut calculations based on the present volume of the primary growing stock are of value for about ten years. During this period, woods operations and tree growth will alter the structure of the primary growing stock. Therefore, on expiration of the initial ten-year period, the allowable cut should be calculated anew, based on the experience of the first ten-year period and in conformity with the actual performance of the forest. With effective forestry practices allowable cuts for the more valuable species will tend, almost certainly, to increase; without them, the proportion of less desirable species in the stands will grow greater.

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Tweed district.*

Species	Annual allowable cut *cu. ft.*
White pine	45,875
Red pine	420
Jack pine	11,700
White spruce	24,510
Black spruce	11,475
Balsam fir	60,500
Hemlock	107,040
White cedar	43,095
Larch	180
TOTAL CONIFERS	304,795
Sugar maple	842,625
Soft maple	71,445
White birch	62,140
Yellow birch	233,240
Beech	184,005
Elm	126,820
Ironwood	50,880
Red oak	23,265
White oak	350
Poplar	246,120
Black ash	77,100
White ash	54,330
Basswood	270,200
Black cherry	12,570
Butternut	180
Hickory	300
TOTAL HARDWOODS	2,255,570
TOTAL ALL SPECIES	2,560,365

[1] Method of calculation of allowable cut is given in Appendix, allowable cut, method, page 31.

[2] Rotation by species, table 16, page 31.

Typical maple bush.

The annual allowable cut, or net depletion allowable under management in the Tweed district, is 54,255,310 cubic feet: 2,560,365 cubic feet from Crown lands and 51,694,945 cubic feet from patented lands. Of the total allowable cut, 5 per cent is on Crown lands and 95 per cent on patented lands. This considerable difference partially results from a more conservative approach to the process of regulating yield on Crown lands. On areas administered by the Crown only mature timber may be utilized. Thus a longer rotation and a different calculation is used for the calculation of the allowable cut.

CROWN LAND

The annual allowable cut for Crown land represents only 0.2 per cent of the primary growing stock, which is composed primarily of immature timber, or 3 cubic feet per acre for the productive forest area. Of the total allowable cut, 304,795 cubic feet, or 12 per cent, is coniferous species and 2,255,570 cubic feet, or 88 per cent, is hardwood species. Since the rotation age is on the average longer for conifers than for hardwoods, the annual allowable cut for conifers is 0.1 per cent of the coniferous primary growing stock and 0.2 per cent for the hardwoods.

The annual allowable cut for the species making up the coniferous content (table 12) shows that 35 per cent is hemlock, 20 per cent balsam fir, 15 per cent

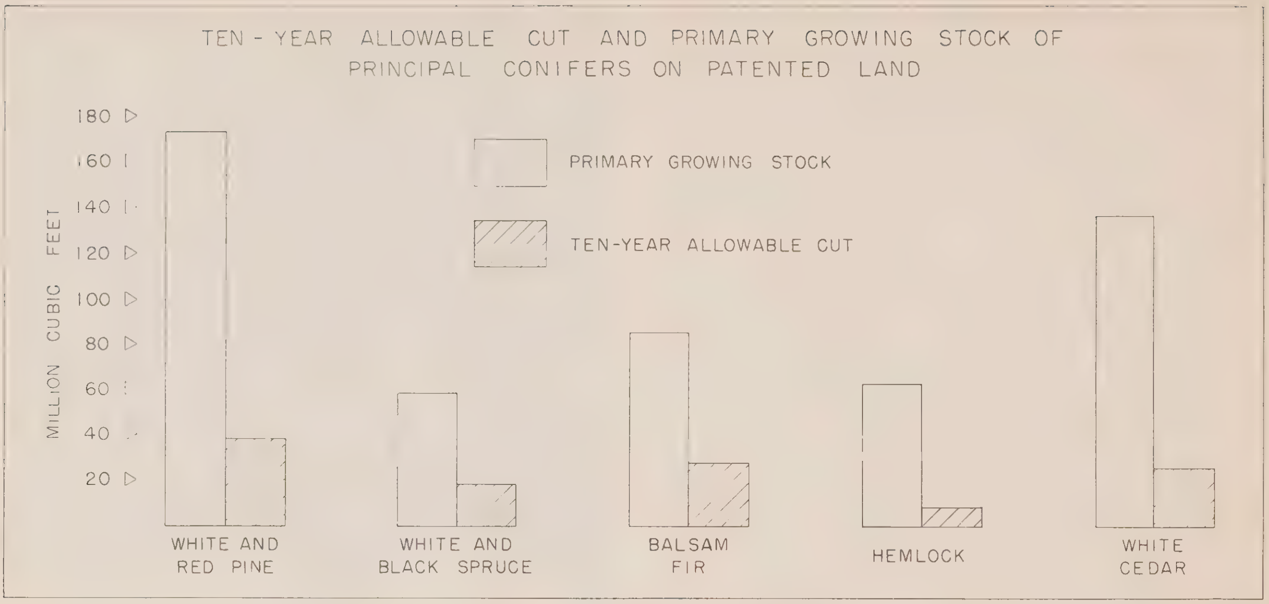


FIGURE 15

white and red pine, 14 per cent white cedar, 12 per cent white and black spruce, and 4 per cent other conifers.

The species making up the hardwood content (table 12) shows that 37 per cent is sugar maple, 12 per cent basswood, 11 per cent poplar, 10 per cent yellow birch, 8 per cent beech, and 6 per cent elm. Ten species combine to form the remaining 16 per cent of the allowable cut.

PATENTED LAND

The annual allowable cut for patented lands amounts to 51,694,945 cubic feet, which represents 2.8 per cent of the primary growing stock, or 40 cubic feet per acre for the productive forest land. The annual allowable cut is 2.2 per cent of the primary growing stock for conifers and 3.0 per cent for hardwoods.

The annual allowable cut for coniferous species on patented lands (table 13) is 11,670,990 cubic feet, or 23 per cent of the total and 40,023,955 cubic feet, or 77 per cent, for hardwoods. White and red pine comprise 32 per cent of the coniferous allowable cut; balsam fir 23 per cent, white cedar 22 per cent, white and black spruce 15 per cent, and hemlock 7 per cent. Sugar maple and poplar comprise over one-half of the hardwood allowable cut, contributing 16 per cent and 41 per cent respectively. Soft maple comprises 11 per cent of the allowable cut, white birch 8 per cent, elm 7 per cent and basswood 5 per cent. The relationship of the ten-year allowable cut to the primary growing stock is shown graphically for conifers in figure 15, and hardwoods in figure 16.

TABLE 13. — *Annual qllowable cut for all species on patented lands in the Tweed district.*

Species	Annual allowable cut *cu. ft.*
White pine	3,286,935
Red pine	479,595
Jack pine	27,420
Pitch pine	3,905
White spruce	1,645,125
Black spruce	117,105
Balsam fir	2,655,435
Hemlock	774,850
White cedar	2,549,005
Red cedar	17,140
Larch	114,475
TOTAL CONIFERS	11,670,990
Sugar maple	6,293,175
Soft maple	4,233,095
White birch	3,007,720
Yellow birch	1,048,265
Beech	669,390
Elm	2,844,805
Ironwood	533,510
Red oak	1,471,255
White oak	98,100
Poplar	16,453,000
Black ash	726,395
White ash	603,825
Basswood	1,852,720
Black cherry	110,325
Butternut	24,880
Hickory	53,495
TOTAL HARDWOODS	40,023,955
TOTAL ALL SPECIES	51,694,945

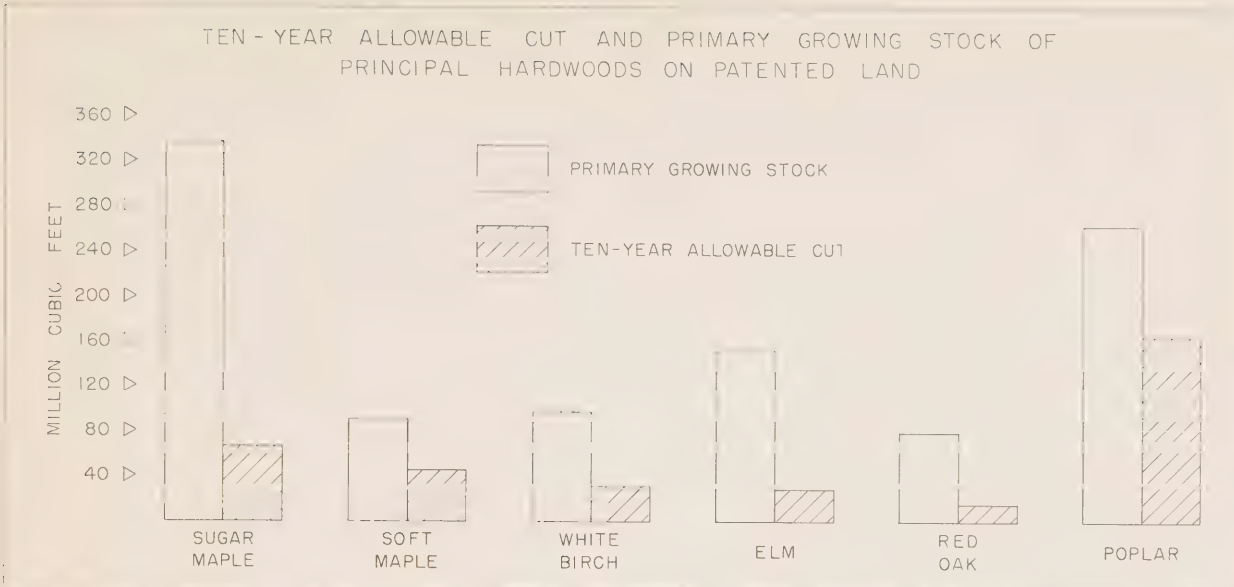


FIGURE 16

Striking contrast between grazed and ungrazed woodlots.

Utilization vs. Allowable Cut

According to the Classification of Annual Timber Returns for the years ending March 31, 1946–1949[1] inclusive, the average annual amounts of wood and wood products cut on Crown lands in the Tweed district were as follows:

Logs and booms	20,308,330 F.B.M. Doyle rule
Piling	717.77 cubic feet
Poles	338 pieces
Posts	3,033 pieces
Ties	328 pieces
Shingle bolts	1.28 cords
Lagging	11.85 cords
Fuelwood	3,705.12 cords
Pulpwood	4,086.27 cords

By the use of appropriate converting factors, these amounts are expressed in gross total cubic feet by species (table 14) and may be compared to the allowable cut figures (table 15).

A comparison of the annual allowable cut with the actual cut by species (table 15) indicates that, on the whole, utilization was more than the allowable cut. Red and white pine, hemlock, the two spruces and balsam fir are all being heavily overcut (fig. 17).

TABLE 14. — *Gross total cubic-foot volumes of wood utilized annually from Crown land in the Tweed district.*

Species	Wood utilized *cu. ft.*	Total *per cent*
Pine, white and red	2,927,122	26
Jack pine	158	*
Spruce, white and black	908,685	8
Balsam fir	170,867	2
Hemlock	2,453,969	22
White cedar	57,167	1
Larch	4,211	*
TOTAL CONIFERS	6,522,179	59
Sugar maple	1,812,486	16
Yellow birch	802,945	7
Beech	149,446	1
Elm	88,977	1
Red oak	56,359	1
Poplar	1,216,722	11
Ash, black and white	33,956	*
Basswood	452,642	4
Black cherry	3,614	*
TOTAL HARDWOODS	4,617,147	41
TOTAL ALL SPECIES	11,139,326	100

* Less than 0.50 per cent.

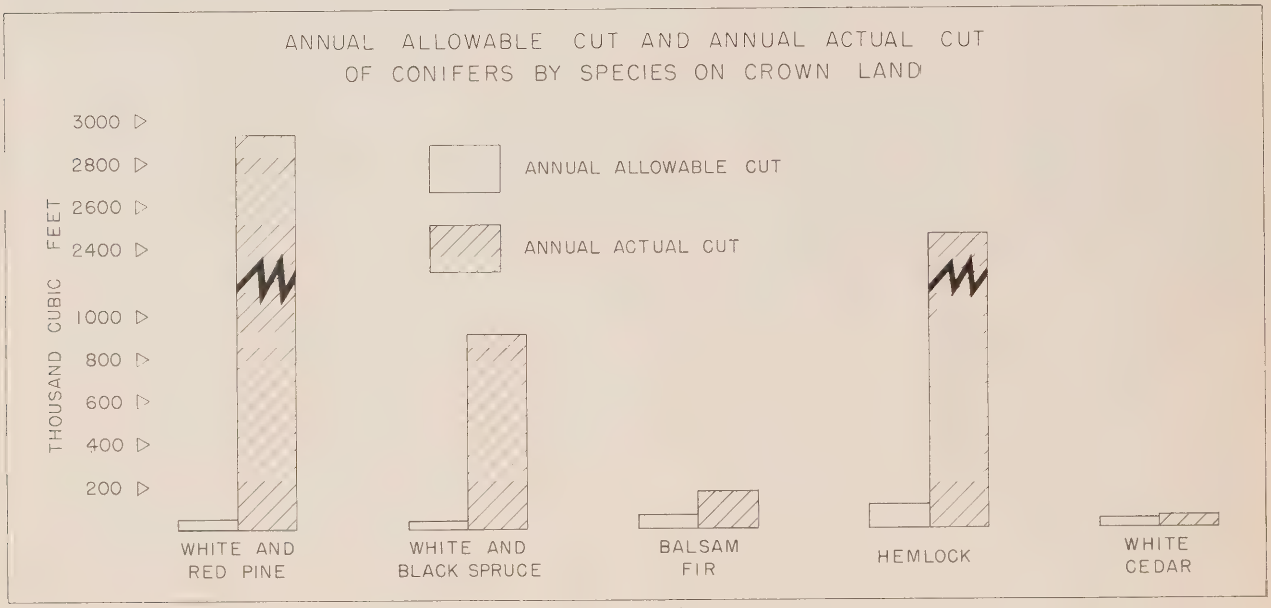


FIGURE 17

Of the hardwoods, sugar maple, yellow birch, red oak, poplar and basswood are all being overcut (fig. 18). In general, conifers were cut at a rate 21 times the allowable cut, while the hardwood cut is approximately double the allowable cut.

When the presently immature stands — which cover 85 per cent of the area — reach maturity, the allowable cut on Crown lands will increase to some 25 million cubic feet, of which approximately one-third will be poplar.

Complete statistics of the quantity of timber utilized from patented lands in the Tweed district are not readily available. Some indication of their

[1] Reports of the Minister of Lands and Forests, for the Province of Ontario, for the fiscal years ending March 31, 1947–1950.

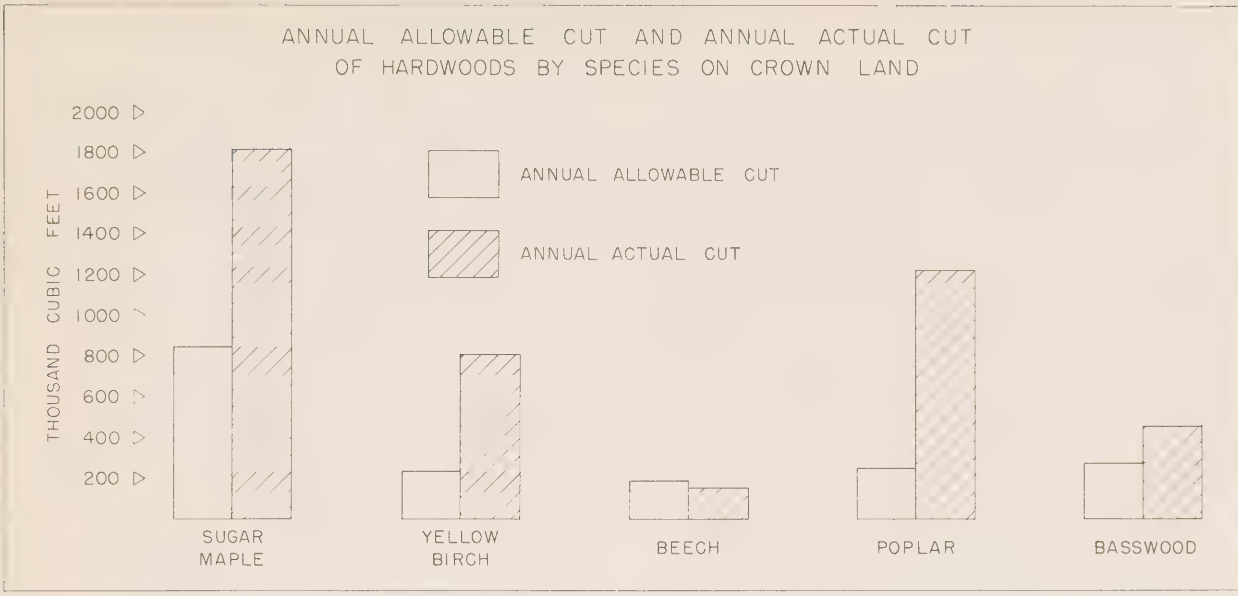


FIGURE 18

Second growth maple stand.

size and value may, however, be obtained from the volume of timber cut on farm woodlots[1]. During 1950, farm woodlots within the Tweed district produced:

Fuelwood	78,806 cords
Pulpwood	19,461 cords
Pit props	25 cords
Logs	15,117,647 board feet
Posts	64,282 pieces
Poles	3,653 pieces

Since these data do not include all the timber obtained from patented lands, no comparison with the calculated allowable cut is possible.

It is estimated[1] that forest products, including maple sugar and maple syrup, obtained from the farm woodlots of this district in 1950 had a cash value of $1,738,295. Of this figure, the farmers received in cash $1,026,041 from the sale of products from their woodlots.

TABLE 15. — *Comparison of allowable cut with actual utilization by species on Crown land.*

Species	Allowable cut *Thousand cu. ft.*	Actual cut *Thousand cu. ft.*
Pine, white and red	46	2,927
Jack pine	12	
Spruce, white and black	36	909
Balsam fir	61	171
Hemlock	107	2,454
White cedar	43	57
Larch	......	4
TOTAL CONIFERS	305	6,522
Sugar maple	843	1,812
Yellow birch	233	803
Beech	184	149
Elm	127	89
Red oak	23	56
Poplar	246	1,217
Ash, black and white	131	34
Basswood	270	453
Black cherry	13	4
Other hardwoods	185	
TOTAL HARDWOODS	2,255	4,617
TOTAL ALL SPECIES	2,560	11,139

[1] Census of Canada, 1951, Volume VI, table 27.

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs on a scale of four inches to the mile (1/15,840). Following the photography, planimetric base maps were prepared by the Slotted Templet Method for the northern part of the district, and semi-controlled photo maps were prepared for the predominantly agricultural area in the south (fig. 19).

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario a photo map covers 7′ 30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map the prints are mounted on a hard-surface non-porous board, such as masonite, upon which control points have been plotted. The road network of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted and makes the edges of the prints less perceptible to the eye and the camera. After a liberal application of adhesive, the print is oriented on to the control and adjusted to coincide with detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the photo map, it is photographed in two sections, producing an east and west half for each sheet. Upon production of the negative, prints are readily available.

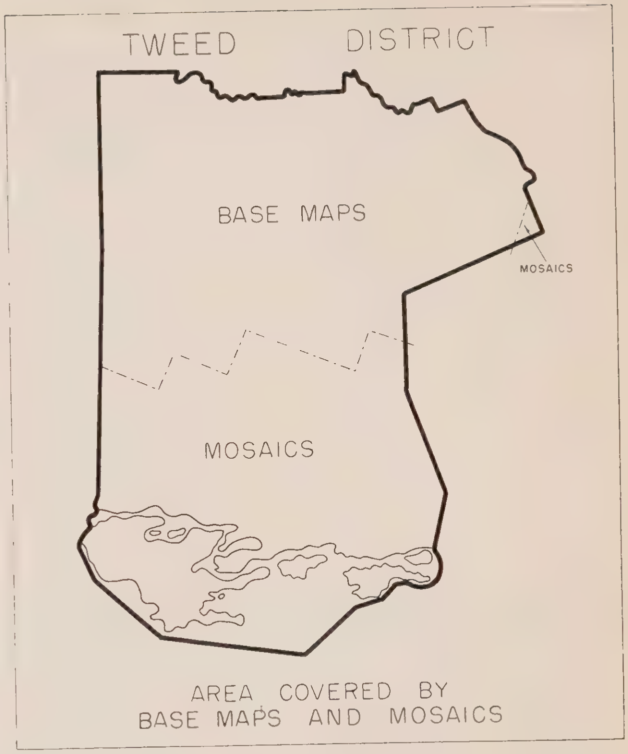


FIGURE 19

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the appropriate planimetric map or mosaic. In each case the forest data were drafted on a linen overlay, and ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1946, 1948, 1949 and 1953, and field sampling was carried out in the summers of 1949, 1951, 1954 and 1955. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. In the northern part of the district two age classes, mature and immature, were used; while in the south, an additional classification — all-aged — was added. The volume per acre of each cover type for the mature and immature age classes was then summarized from the field tallies into four density

[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department of Lands and Forests, Ontario, Parts II and III.

classes for the northern area, and three for the southern. The all-aged stands were not segregated into density classes. These summaries were made separately for the two ecological sections in the Tweed district and for the different years during which field data were collected. The per acre volumes in cubic feet, made up in this manner, are shown in tables 17, 18 and 19. Additional tables covering the Algonquin Section 1949 may be found in Report No. 7 of the Algonquin (Pembroke) district.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by taking the total mature volume for each species and dividing by the rotation age for the species. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 18 cubic feet per acre, and for patented lands to 28 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years, and the mature age class from 30 to 300 years, depending on the species. Stands classified as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered except jack pine, where a rotation of 70 years has been accepted as more suitable than that of 60 years. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 16).

TABLE 16. — *Rotation by species.*

Species	Crown land	Patented land
	years	*years*
White pine	120	90
Red pine	100	60
Jack pine	70	40
Pitch pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Red cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100
Butternut	100	100
Hickory	100	100

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotation ages.

The compilation was carried out in such a way that the volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory, for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

[1] Manual of Timber Management, Department of Lands and Forests, Ontario — Part II, page 50.

[2] L. Pardé — Traité pratique d'aménagement des forêts, Paris, 1930.

(b) FORMULA

In the present calculations, the following formulae were used:

(1) Crown land: $$P = \frac{V.1.}{n/3}$$

(2) Patented land: $$P = \frac{\frac{5}{8}\,(V.1. + V.2. + V.3.)}{n/3}$$

where:

V.1. — denotes volume of mature timber (Age Class I).
V.2. — denotes volume of immature timber (Age Class II).
V.3. — denotes volume of mature and immature timber in all-aged stands.
n — denotes rotation.
P — denotes annual allowable cut.

The decision to use formula (1) for Crown lands was made for the following reasons. Mature stands comprise only 5 per cent of the productive forest area within the Tweed district. This indicates a deficit of mature timber and, consequently, the need of reducing the annual cut. The immature age class, in contrast to the mature, shows a considerable surplus in area. Before these immature stands reach maturity, a period equal to approximately one-third of the rotation may elapse. During this period, only the presently mature stock can be cut from Crown lands in accordance with the practice in Ontario to limit utilization on Crown lands to mature timber. In accordance with the foregoing, formula (1) was used in the calculation of the annual allowable cut for Crown lands, whereby only mature timber shall be cut during the initial period, on expiration of which a new mature stand will become available for utilization.

The patented lands require a different solution to the problem of regulating yield, thus formula (2) was used. Patented lands, similar to Crown, have a deficit of mature and an excess of immature age class. Considering the deficit of mature timber and the heavy demand for wood in a relatively densely populated area, it may be assumed that the required timber will be obtained by cutting a portion of the immature stands. In view of this, the allowable cut for patented lands was based on both the mature and immature volumes with the objective of obtaining a balanced yield over a period of approximately two-thirds rotation.

With the aid of these formulae, the allowable cut has been calculated separately for each species, with full consideration of the actual growing stock of each species and the appropriate rotation. The results of the individual calculations for each species have been totalled and shown as allowable cut for Crown lands and for patented lands, respectively.

An improvement cut yields valuable logs.

Common and Botanical Names of Tree Species included in Timber Estimates

Conifers

White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Jack pine	*Pinus Banksiana Lamb.*
Pitch pine	*Pinus rigida Mill.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Red cedar	*Juniperus virginiana L.*
Larch	*Larix laricina (Du Roi) K. Koch*

Hardwoods

Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.*
	Acer saccharinum L.
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.*
	Ulmus rubra Muhl.
	Ulmus Thomasi Sarg.
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.*
White oak	*Quercus alba L.*
Poplar	*Populus tremuloides Michx.*
	Populus balsamifera L.
	Populus grandidentata Michx.
	Populus deltoides Marsh.
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.*
	Fraxinus pennsylvanica Marsh.
	Var. Subintegerrima (Vahl) Fern.
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch*
	Carya cordiformis (Wang.) K. Koch

TABLE 17. — *Volume of the primary growing stock in cubic feet per acre.*
Algonquin Section — 1951

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	4	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	4
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	59.4	56.3	44.2	18.6	82.5	78.8	65.1	0.4
	10″ up	144.1	136.5	107.2	45.1	312.1	298.3	246.6	222.1
Red pine	4″–9″	18.0	17.1	13.4	5.6	16.8	16.1	13.3	14.6
	10″ up	....	....	....	....	24.7	23.6	19.5	93.1
Jack pine	4″–9″	277.4	262.9	206.4	86.8	....	....	....	49.1
	10″ up	72.9	69.1	54.2	22.8	....	....	....	....
White spruce	4″–9″	35.0	33.2	26.0	10.9	90.8	86.8	71.7	39.0
	10″ up	26.8	25.4	20.0	8.4	140.2	134.0	110.8	10.9
Black spruce	4″–9″	109.4	103.7	81.4	34.2	32.9	31.4	26.0	....
	10″ up	202.3	191.7	150.4	63.3	16.4	15.7	13.0	....
Balsam fir	4″–9″	102.1	96.7	75.9	31.9	215.3	205.8	170.1	78.8
	10″ up	62.8	59.5	46.7	19.7	49.5	47.3	39.1	....
Hemlock	4″–9″	116.7	110.6	86.8	36.5	32.5	31.1	25.6	2.6
	10″ up	249.1	236.0	185.3	78.0	55.8	53.3	44.1	....
White cedar	4″–9″	106.1	100.5	78.9	33.2	647.4	618.7	511.4	129.0
	10″ up	82.0	77.7	61.0	25.6	354.7	339.0	280.3	17.3
Larch	4″–9″	7.7	7.3	5.7	2.4	44.5	42.5	35.2	....
	10″ up	....	....	....	....	25.6	24.5	20.2	....
TOTAL CONIFERS	4″–9″	831.8	788.3	618.7	260.1	1162.7	1111.2	918.4	313.5
	10″ up	840.0	795.9	624.8	262.9	979.0	935.7	773.6	343.4
Sugar maple	4″–9″	6.5	6.2	4.8	2.0	8.3	7.9	6.5	1.8
	10″ up	253.7	240.3	188.7	79.4	15.1	14.4	12.0	....
Yellow birch	4″–9″	11.5	10.9	8.6	3.6	11.9	11.4	9.4	....
	10″ up	202.3	191.7	150.4	63.3	37.4	35.7	29.6	....
Elm	4″–9″	....	....	....	....	24.0	22.9	18.9	6.1
	10″ up	154.6	146.5	115.0	48.4	22.7	21.8	18.0	....
Ironwood	4″–9″	....	....	....	....	7.0	6.7	5.6	4.4
	10″ up	....	....	....	....	0.8	0.7	0.6	....
Oak	4″–9″	....	....	....	....	....	....	....	4.4
	10″ up	....	....	....	....	....	....	....	....
White birch	4″–9″	2.7	2.6	2.0	0.9	43.3	41.4	34.2	....
	10″ up	25.6	24.3	19.1	8.0	29.4	28.1	23.2	....
Poplar (all)	4″–9″	61.2	58.0	45.5	19.2	65.2	62.4	51.5	28.3
	10″ up	101.1	95.8	75.2	31.6	119.1	113.8	94.1	174.1
Red maple	4″–9″	29.3	27.7	21.8	9.1	3.5	3.3	2.8	....
	10″ up	17.1	16.2	12.7	5.4	4.3	4.1	3.4	....
Ash	4″–9″	27.5	26.1	20.4	8.6	42.7	40.8	33.8	....
	10″ up	11.1	10.5	8.3	3.5	19.6	18.7	15.4	....
TOTAL HARDWOODS	4″–9″	138.7	131.5	103.1	43.4	205.9	196.8	162.7	45.0
	10″ up	765.5	725.3	569.4	239.6	248.4	237.3	196.3	174.1
GRAND TOTAL	4″–9″	970.5	919.8	721.8	303.5	1368.6	1308.0	1081.1	358.5
	10″ up	1605.5	1521.2	1194.2	502.5	1227.4	1173.0	969.9	517.5
TOTAL 4″ UP		2576.0	2441.0	1916.0	806.0	2596.0	2481.0	2051.0	876.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
White pine	4″–9″	....	....	....	....	7.9	7.5	5.9	4.9
	10″ up	....	....	....	....	44.4	42.0	33.0	38.5
White spruce	4″–9″	....	....	....	....	3.4	3.2	2.5	....
	10″ up	....	....	....	....	6.6	6.3	5.0	....
Balsam fir	4″–9″	10.5	10.2	8.9	6.8	23.3	22.0	17.4	7.3
	10″ up	4.8	4.7	4.1	....	4.8	4.6	3.6	2.8
Hemlock	4″–9″	15.2	14.8	12.9	8.1	10.2	9.7	7.6	....
	10″ up	128.4	125.2	108.9	22.9	28.0	26.5	20.9	....
White cedar	4″–9″	5.3	5.2	4.5	....	10.6	10.0	7.9	....
	10″ up	13.0	12.7	11.0	5.4	7.5	7.1	5.6	....
TOTAL CONIFERS	4″–9″	31.0	30.2	26.3	14.9	55.4	52.4	41.3	12.2
	10″ up	146.2	142.6	124.0	28.3	91.3	86.5	68.1	41.3

Table 17 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	4	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	314.7	306.8	266.9	72.8	332.8	315.1	248.0	53.4
	10″ up	1258.7	1227.4	1067.5	773.7	308.4	292.0	229.8	79.5
Yellow birch	4″–9″	36.0	35.1	30.6	1.6	40.7	38.5	30.3	5.8
	10″ up	232.8	227.1	197.4	142.8	53.8	50.9	40.1	10.6
Beech	4″–9″	76.7	74.8	65.1	16.5	41.3	39.2	30.8	....
	10″ up	286.9	279.7	243.2	59.1	67.2	63.6	50.1	....
Elm	4″–9″	18.8	18.4	16.0	9.6	43.5	41.2	32.5	21.0
	10″ up	121.7	118.6	103.2	78.1	71.1	67.3	52.9	26.9
Ironwood	4″–9″	40.4	39.4	34.3	18.9	55.7	52.8	41.5	8.8
	10″ up	8.5	8.3	7.2	....	4.6	4.3	3.4	0.7
Oak	4″–9″	7.6	7.4	6.5	6.0	71.8	67.9	53.5	47.1
	10″ up	38.2	37.3	32.4	33.2	79.0	74.8	58.9	29.1
White birch	4″–9″	11.8	11.5	10.0	1.4	97.2	92.1	72.5	24.9
	10″ up	15.7	15.3	13.3	....	31.4	29.7	23.4	8.5
Poplar (all)	4″–9″	22.8	22.2	19.3	....	179.4	169.8	133.7	124.1
	10″ up	44.4	43.3	37.7	....	120.1	113.7	89.5	51.0
Red maple	4″–9″	12.7	12.4	10.8	....	43.0	40.7	32.0	29.3
	10″ up	5.6	5.5	4.7	....	17.3	16.4	12.9	14.8
Ash	4″–9″	34.9	34.0	29.6	1.8	57.9	54.8	43.1	12.0
	10″ up	53.7	52.4	45.5	49.5	28.5	27.0	21.3	8.8
Basswood	4″–9″	26.8	26.1	22.7	....	42.6	40.4	31.8	6.1
	10″ up	196.2	191.4	166.4	41.8	63.9	60.5	47.6	14.1
Black cherry	4″–9″	6.6	6.3	5.6	....	10.1	9.6	7.5	....
	10″ up	5.6	5.5	4.8	....	2.0	1.8	1.5	....
Total Hardwoods	4″–9″	609.8	594.4	517.4	128.6	1016.0	962.1	757.2	332.5
	10″ up	2268.0	2211.8	1923.3	1178.2	847.3	802.0	631.4	244.0
GRAND TOTAL	4″–9″	640.8	624.6	543.7	143.5	1071.4	1014.5	798.5	344.7
	10″ up	2414.2	2354.4	2047.3	1206.5	938.6	888.5	699.5	285.3
TOTAL 4″ UP		3055.0	2979.0	2591.0	1350.0	2010.0	1903.0	1498.0	630.0
		MIXEDWOODS MATURE (M-I)				MIXEDWOODS IMMATURE (M-II)			
White pine	4″–9″	18.3	17.3	13.6	....	86.6	80.2	61.3	30.1
	10″ up	202.0	191.2	150.1	....	303.6	281.1	214.9	148.1
Red pine	4″–9″	....	....	....	....	15.0	13.9	10.6	3.4
	10″ up					34.8	32.2	24.6	6.2
White spruce	4″–9″	28.8	27.2	21.4	....	56.8	52.6	40.2	24.0
	10″ up	81.4	77.1	60.5	....	76.8	71.1	54.4	59.1
Black spruce	4″–9″	15.3	14.5	11.4	....	8.8	8.1	6.2	....
	10″ up	16.2	15.3	12.0	....	4.3	4.0	3.1	....
Balsam fir	4″–9″	136.4	129.2	101.4	2.5	211.8	196.2	150.0	33.9
	10″ up	36.7	34.7	27.3	....	42.2	39.0	29.8	18.8
Hemlock	4″–9″	106.4	100.7	79.1	54.7	40.7	37.7	28.8	13.2
	10″ up	731.5	692.5	543.7	....	61.4	56.9	43.5	39.5
White cedar	4″–9″	89.1	84.3	66.2	46.5	171.4	158.7	121.3	12.9
	10″ up	205.9	195.0	153.1	14.5	74.8	69.3	53.0	3.1
Larch	4″–9″	....	....	....	....	2.2	2.0	1.6	....
	10″ up					0.4	0.4	0.3	
Total Conifers	4″–9″	394.3	373.2	293.1	103.7	593.3	549.4	420.0	117.5
	10″ up	1273.7	1205.8	946.7	14.5	598.3	554.0	423.6	274.8
Sugar maple	4″–9″	115.7	109.5	86.0	18.3	95.4	88.3	67.6	34.8
	10″ up	612.1	579.4	454.9	450.7	77.5	71.7	54.8	96.2
Yellow birch	4″–9″	49.2	46.5	36.5	....	27.3	25.3	19.3	2.2
	10″ up	363.9	344.5	270.5	27.4	64.4	59.6	45.6	11.4
Beech	4″–9″	35.6	33.7	26.5	8.7	8.1	7.5	5.7	1.5
	10″ up	74.6	70.6	55.4	....	12.9	11.9	9.1	9.7
Elm	4″–9″	23.7	22.4	17.6	....	47.6	44.1	33.7	11.4
	10″ up	145.5	137.7	108.1	164.2	67.6	62.6	47.9	10.2

Table 17 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	4	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Ironwood	4″–9″	11.5	10.9	8.6	15.4	17.1	15.9	12.2	16.2
	10″ up	4.2	4.0	3.1	18.2	1.2	1.1	0.8	3.8
Oak	4″–9″	....	....	....	....	24.0	22.2	17.0	16.8
	10″ up	....	....	....	22.4	23.1	21.4	16.4	25.5
White birch	4″–9″	41.3	39.1	30.7	....	133.9	124.0	94.8	17.5
	10″ up	68.9	65.2	51.2	19.9	59.9	55.4	42.4	4.8
Poplar (all)	4″–9″	53.7	50.9	40.0	....	258.2	239.1	182.8	45.0
	10″ up	217.7	206.1	161.8	....	278.7	258.0	197.3	67.7
Red maple	4″–9″	43.1	40.8	32.0	....	58.4	54.1	41.3	19.6
	10″ up	74.9	70.9	55.7	....	25.4	23.5	18.0	5.2
Ash	4″–9″	80.4	76.2	59.8	29.4	66.8	61.8	47.2	4.3
	10″ up	108.4	102.6	80.6	219.4	38.0	35.2	26.9	2.9
Basswood	4″–9″	9.4	8.9	7.0	4.1	12.6	11.7	8.9	....
	10″ up	128.3	121.4	95.3	109.1	24.1	22.3	17.0	....
Black cherry	4″–9″	2.6	2.4	1.9	....	4.2	3.9	3.0	....
	10″ up	1.3	1.3	1.0	18.6	1.0	1.0	0.7	....
Total Hardwoods	4″–9″	466.2	441.3	346.6	75.9	753.6	697.9	533.5	169.3
	10″ up	1799.8	1703.7	1337.6	1049.9	673.8	623.7	476.9	237.4
GRAND TOTAL	4″–9″	860.5	814.5	639.7	179.6	1346.9	1247.3	953.5	286.8
	10″ up	3073.5	2909.5	2284.3	1064.4	1272.1	1177.7	900.5	512.2
TOTAL 4″ UP		3934.0	3724.0	2924.0	1244.0	2619.0	2425.0	1854.0	799.0

Heavy cutting has destroyed this woodlot.

TABLE 18. — *Volume of the primary growing stock in cubic feet per acre. Algonquin Section — 1954–1955*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	ALL-AGED
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	240.2	223.7	167.6	117.6	114.3	87.2	....
	10″ up	1044.1	972.2	728.8	296.5	288.2	219.8	....
Pitch pine	4″–9″	....	....	....	7.0	6.9	5.2	....
	10″ up				5.3	5.1	3.9	
White spruce	4″–9″	5.2	4.9	3.7	13.8	13.5	10.3	....
	10″ up	9.7	9.0	6.7	33.3	32.3	24.7	....
Black spruce	4″–9″	....	....	....	43.1	41.9	31.9	....
	10″ up				12.2	11.9	9.1	
Balsam fir	4″–9″		....		59.0	57.3	43.8	....
	10″ up	....	....	....	16.8	16.4	12.5	....
Hemlock	4″–9″	35.4	33.0	24.7	40.4	39.3	30.0	....
	10″ up	158.3	147.4	110.5	101.0	98.2	74.9	....
White cedar	4″–9″	338.8	315.5	236.5	731.5	711.2	542.4	....
	10″ up	284.0	264.5	198.2	154.1	149.8	114.3	....
Red cedar	4″–9″	....	....	....	1.9	1.9	1.4	....
	10″ up	....	....	....	0.2	0.1	0.1	....
Larch	4″–9″	3.0	2.8	2.1	51.2	49.8	38.0	....
	10″ up	....	....	....	10.3	10.0	7.6	....
TOTAL CONIFERS	4″–9″	622.6	579.9	434.6	1065.5	1036.1	790.2	
	10″ up	1496.1	1393.1	1044.2	629.7	612.0	466.9	....
Sugar maple	4″–9″	5.6	5.2	3.9	5.1	4.9	3.7	....
	10″ up	42.1	39.2	29.4	5.2	5.1	3.9	....
Soft maple	4″–9″	....	....	....	18.5	18.0	13.7	....
	10″ up	23.8	22.2	16.6	12.2	11.9	9.1	....
White birch	4″–9″	13.3	12.4	9.3	10.4	10.1	7.8	....
	10″ up	19.5	18.1	13.6	6.0	5.8	4.4	....
Yellow birch	4″–9″	6.6	6.1	4.6	10.1	9.9	7.5	....
	10″ up	14.3	13.3	10.0	4.3	4.1	3.1	....
Beech	4″–9″	6.4	5.9	4.5	4.3	4.2	3.2	
	10″ up	38.3	35.7	26.7	3.9	3.8	2.9	
Elm	4″–9″	49.7	46.3	34.7	58.2	56.5	43.1	....
	10″ up	269.2	250.6	187.9	77.1	75.0	57.2	....
Ironwood	4″–9″	11.9	11.1	8.3	1.7	1.6	1.2	
	10″ up	....	....	....	0.4	0.4	0.3	....
Red oak	4″–9″	....	....	....	1.9	1.9	1.4	
	10″ up	107.3	99.9	74.9	12.5	12.1	9.2	....
White oak	4″–9″	5.1	4.8	3.6	4.9	4.8	3.6	....
	10″ up	69.4	64.6	48.4	17.6	17.1	13.1	....
Poplar (all)	4″–9″	1.3	1.2	0.9	21.5	20.9	16.0	....
	10″ up	25.5	23.8	17.8	44.1	42.9	32.7	....
Black ash	4″–9″	3.0	2.8	2.1	19.0	18.5	14.1	....
	10″ up	....	....	....	1.5	1.4	1.1	....
White ash	4″–9″				2.8	2.7	2.0	
	10″ up				1.3	1.3	1.0	
Basswood	4″–9″				3.6	3.5	2.7	
	10″ up	149.0	138.8	104.0	6.7	6.5	4.9	....
TOTAL HARDWOODS	4″–9″	102.9	95.8	71.9	162.0	157.5	120.0	....
	10″ up	758.4	706.2	529.3	192.8	187.4	142.9	....
GRAND TOTAL	4″–9″	725.5	675.7	506.5	1227.5	1193.6	910.2	....
	10″ up	2254.5	2099.3	1573.5	822.5	799.4	609.8	....
TOTAL 4″ UP		2980.0	2775.0	2080.0	2050.0	1993.0	1520.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	1.7	1.5	1.1	10.3	9.0	6.4	5.8
	10″ up	26.2	23.5	17.6	31.8	27.7	19.7	26.3
White spruce	4″–9″	0.6	0.5	0.4	0.6	0.6	0.4	0.9
	10″ up	2.5	2.3	1.7	1.1	0.9	0.6	1.3

Table 18 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
	4″–9″	2.4	2.2	1.6	1.6	1.4	0.9	1.7
Balsam fir	10″ up	0.7	0.6	0.5	0.1	0.1	0.1	0.5
	4″–9″	12.2	11.0	8.2	12.2	10.6	7.6	12.3
Hemlock	10″ up	49.8	44.6	33.4	9.7	8.5	6.0	23.3
	4″–9″	10.5	9.5	7.1	12.8	11.1	7.9	12.7
White cedar	10″ up	8.1	7.2	5.4	2.4	2.1	1.5	4.2
	4″–9″	....	....	....	....	....	....	....
Red cedar	10″ up	....	....	....	....	....	....	0.1
	4″–9″	....	....	....	....	....	....	0.3
Larch	10″ up	....	....	....	....	....	....	0.1
	4″–9″	27.4	24.7	18.4	37.5	32.7	23.2	33.7
Total Conifers	10″ up	87.3	78.2	58.6	45.1	39.3	27.9	55.8
	4″–9″	145.4	130.4	97.7	180.0	157.1	111.6	111.4
Sugar maple	10″ up	685.4	614.9	460.5	47.3	41.2	29.3	127.7
	4″–9″	94.7	85.0	63.7	191.7	167.2	118.9	97.7
Soft maple	10″ up	472.6	423.9	317.5	109.7	95.7	68.0	144.9
	4″–9″	2.3	2.1	1.6	41.1	35.9	25.5	12.0
White birch	10″ up	3.9	3.5	2.6	9.4	8.2	5.8	9.2
	4″–9″	23.3	21.0	15.7	16.0	14.0	10.0	22.0
Yellow birch	10″ up	29.4	26.3	19.7	5.9	5.1	3.6	19.1
	4″–9″	36.0	32.3	24.2	18.1	15.8	11.3	16.7
Beech	10″ up	131.4	117.9	88.3	7.2	6.2	4.4	28.0
	4″–9″	120.2	107.8	80.7	149.4	130.3	92.6	131.4
Elm	10″ up	763.3	684.8	512.9	145.3	126.8	90.1	324.1
	4″–9″	22.7	20.3	15.3	32.9	28.7	20.4	20.5
Ironwood	10″ up	2.1	1.9	1.4	0.8	0.7	0.5	1.0
	4″–9″	3.3	3.0	2.2	65.5	57.2	40.6	19.4
Red oak	10″ up	55.6	49.8	37.4	99.5	86.8	61.7	76.5
	4″–9″	3.1	2.7	2.1	24.8	21.6	15.4	12.1
White oak	10″ up	37.2	33.4	25.0	15.6	13.6	9.7	21.8
	4″–9″	6.4	5.7	4.3	86.2	75.2	53.4	16.5
Poplar (all)	10″ up	12.2	11.0	8.2	80.5	70.2	49.9	32.7
	4″–9″	43.6	39.1	29.3	65.7	57.3	40.7	51.3
Black ash	10″ up	18.4	16.5	12.4	5.0	4.4	3.1	7.5
	4″–9″	13.9	12.5	9.3	44.4	38.7	27.5	21.2
White ash	10″ up	57.4	51.5	38.6	23.0	20.1	14.3	30.4
	4″–9″	12.4	11.1	8.3	56.5	49.3	35.0	18.7
Basswood	10″ up	155.0	139.1	104.2	53.0	46.2	32.9	70.9
	4″–9″	1.1	1.0	0.7	2.7	2.3	1.7	1.1
Black cherry	10″ up	2.0	1.8	1.4	0.7	0.6	0.4	0.8
	4″–9″	1.5	1.3	1.0	2.2	1.9	1.4	2.0
Butternut	10″ up	10.9	9.8	7.3	4.5	4.0	2.8	4.4
	4″–9″	6.8	6.1	4.6	13.6	11.9	8.4	5.8
Hickory	10″ up	11.8	10.6	7.9	3.2	2.8	2.0	4.7
	4″–9″	536.7	481.4	360.7	990.8	864.4	614.4	559.8
Total Hardwoods	10″ up	2448.6	2196.7	1645.3	610.6	532.6	378.5	903.7
	4″–9″	564.1	506.1	379.1	1028.3	897.1	637.6	593.5
GRAND TOTAL	10″ up	2535.9	2274.9	1703.9	655.7	571.9	406.4	959.5
TOTAL 4″ UP		3100.0	2781.0	2083.0	1684.0	1469.0	1044.0	1553.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
	4″–9″	51.8	50.8	45.4	47.5	46.4	36.2	33.8
White pine	10″ up	372.7	365.7	327.2	92.9	90.8	71.0	132.2
	4″–9″	....	....	....	1.2	1.2	0.9	....
Red pine	10″ up	....	....	....	0.6	0.5	0.4	....
	4″–9″	....	....	....	1.1	1.1	0.9	1.5
Pitch pine	10″ up	....	....	....	2.4	2.3	1.8	2.4

Table 18 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White spruce	4″–9″	4.1	4.0	3.6	10.7	10.4	8.2	3.3
	10″ up	27.9	27.4	24.5	17.4	17.0	13.2	13.2
Black spruce	4″–9″	....	....	....	1.5	1.4	1.1	0.2
	10″ up	....	....	....	0.3	0.3	0.2	....
Balsam fir	4″–9″	7.3	7.2	6.5	24.8	24.3	18.9	10.6
	10″ up	8.7	8.5	7.6	5.0	4.9	3.9	2.9
Hemlock	4″–9″	84.3	82.7	74.0	99.0	96.8	75.6	76.5
	10″ up	236.1	231.6	207.2	67.7	66.1	51.7	109.4
White cedar	4″–9″	112.2	110.0	98.5	200.9	196.5	153.5	108.6
	10″ up	90.7	89.0	79.6	32.4	31.7	24.8	52.1
Red cedar	4″–9″	..	.	.	..	.. ..	.	0.7
	10″ up	.	.	. .				
Larch	4″–9″	1.3	1.2	1.1	14.2	13.9	10.9	3.5
	10″ up	1.4	1.4	1.2	1.6	1.5	1.2	2.0
Total Conifers	4″–9″	261.0	255.9	229.1	400.9	392.0	306.2	238.7
	10″ up	737.5	723.6	647.3	220.3	215.1	168.2	314.2
Sugar maple	4″–9″	62.2	61.1	54.6	39.7	38.8	30.3	51.5
	10″ up	268.9	263.7	235.9	30.5	29.8	23.3	69.4
Soft maple	4″–9″	44.9	44.0	39.4	119.8	117.0	91.5	58.5
	10″ up	142.0	139.3	124.6	69.7	68.2	53.2	79.6
White birch	4″–9″	6.0	5.9	5.3	49.3	48.1	37.6	15.2
	10″ up	12.7	12.4	11.1	13.9	13.6	10.6	11.4
Yellow birch	4″–9″	24.8	24.4	21.8	23.8	23.2	18.2	31.0
	10″ up	52.6	51.6	46.1	14.8	14.5	11.3	37.7
Beech	4″–9″	17.3	16.9	15.1	10.5	10.3	8.0	10.0
	10″ up	84.2	82.6	73.9	7.1	6.9	5.4	19.2
Elm	4″–9″	71.7	70.3	62.9	160.6	157.0	122.6	88.9
	10″ up	406.2	398.6	356.6	183.3	179.2	140.1	254.4
Ironwood	4″–9″	18.6	18.3	16.3	13.3	13.0	10.2	13.4
	10″ up	8.1	7.9	7.1	0.7	0.7	0.5	1.1
Red oak	4″–9″	4.3	4.2	3.8	20.8	20.3	15.9	9.6
	10″ up	91.8	90.1	80.5	35.4	34.6	27.0	60.8
White oak	4″–9″	11.4	11.2	10.0	12.3	12.0	9.4	15.9
	10″ up	66.0	64.8	57.9	15.8	15.4	12.0	31.6
Poplar (all)	4″–9″	7.9	7.8	7.0	74.6	72.9	57.0	17.9
	10″ up	40.2	39.3	35.2	120.2	117.6	91.8	46.2
Black ash	4″–9″	35.8	35.0	31.4	57.8	56.4	44.1	41.4
	10″ up	12.3	12.1	10.8	5.4	5.3	4.1	6.4
White ash	4″–9″	6.0	5.8	5.2	8.4	8.2	6.5	11.0
	10″ up	28.7	28.2	25.3	7.4	7.2	5.6	15.5
Basswood	4″–9″	7.9	7.8	6.9	13.0	12.8	10.0	10.6
	10″ up	117.6	115.3	103.2	16.8	16.4	12.8	47.3
Black cherry	4″–9″	0.6	0.6	0.5	0.9	0.9	0.7	1.7
	10″ up	2.1	2.0	1.8	0.9	0.8	0.6	2.1
Butternut	4″–9″	0.3	0.3	0.3	2.7	2.6	2.1	0.5
	10″ up	5.0	4.9	4.4	2.6	2.5	1.9	3.5
Hickory	4″–9″	4.9	4.8	4.3	1.3	1.2	0.9	2.1
	10″ up	8.5	8.3	7.4	0.5	0.5	0.4	1.7
Total Hardwoods	4″–9″	324.6	318.4	284.8	608.8	594.7	465.0	379.2
	10″ up	1346.9	1321.1	1181.8	525.0	513.2	400.6	687.9
GRAND TOTAL	4″–9″	585.6	574.3	513.9	1009.7	986.7	771.2	617.9
	10″ up	2084.4	2044.7	1829.1	745.3	728.3	568.8	1002.1
TOTAL 4″ UP		2670.0	2619.0	2343.0	1755.0	1715.0	1340.0	1620.0

TABLE 19. — *Volume of the primary growing stock in cubic feet per acre.*
Huron Section — 1954–1955

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	CONIFEROUS MATURE (C-I) Density Class 2	CONIFEROUS MATURE (C-I) Density Class 3	CONIFEROUS IMMATURE (C-II) Density Class 1	CONIFEROUS IMMATURE (C-II) Density Class 2	CONIFEROUS IMMATURE (C-II) Density Class 3	ALL-AGED
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	26.3	24.1	16.9	26.4	23.1	15.2	....
	10″ up	294.9	269.2	189.1	72.9	63.9	41.8	....
White spruce	4″–9″	10.6	9.7	6.8	36.1	31.6	20.7	....
	10″ up	36.4	33.2	23.4	36.0	31.5	20.6	....
Black spruce	4″–9″	4.5	4.1	2.9	10.8	9.6	6.2	....
	10″ up	3.3	3.1	2.1	2.8	2.4	1.6	....
Balsam fir	4″–9″	31.0	28.3	19.9	51.5	45.1	29.5	....
	10″ up	8.2	7.5	5.2	6.9	6.1	4.0	....
Hemlock	4″–9″	54.0	49.4	34.7	16.0	14.0	9.2	....
	10″ up	141.8	129.5	90.9	19.1	16.7	10.9	....
White cedar	4″–9″	855.6	781.6	548.9	1004.4	879.6	575.9	....
	10″ up	575.2	525.4	369.0	180.0	157.7	103.2	....
Red cedar	4″–9″	72.3	66.0	46.4	49.1	43.0	28.1	....
	10″ up	42.6	38.9	27.3	9.3	8.2	5.4	....
Larch	4″–9″	14.3	13.1	9.1	51.5	45.1	29.5	....
	10″ up	4.0	3.6	2.6	5.0	4.4	2.9	....
TOTAL CONIFERS	4″–9″	1068.6	976.3	685.6	1245.8	1091.1	714.3	....
	10″ up	1106.4	1010.4	709.6	332.0	290.9	190.4	....
Sugar maple	4″–9″	5.2	4.8	3.4	4.2	3.7	2.4	....
	10″ up	60.1	54.8	38.5	5.5	4.8	3.2	....
Soft maple	4″–9″	4.7	4.2	3.0	3.0	2.7	1.8	....
	10″ up	5.8	5.3	3.7	4.8	4.1	2.7	....
White birch	4″–9″	17.2	15.7	11.1	25.1	21.9	14.4	....
	10″ up	19.4	17.7	12.4	10.0	8.8	5.7	....
Yellow birch	4″–9″	15.1	13.8	9.7	10.6	9.3	6.1	....
	10″ up	18.8	17.2	12.1	6.9	6.1	4.0	....
Beech	4″–9″	1.7	1.6	1.1	0.5	0.4	0.3	....
	10″ up	16.6	15.1	10.6	1.5	1.3	0.8	....
Elm	4″–9″	29.9	27.3	19.2	69.9	61.2	40.0	....
	10″ up	108.5	99.1	69.6	95.7	83.8	54.9	....
Ironwood	4″–9″	5.6	5.2	3.6	2.0	1.7	1.1	....
	10″ up	2.2	2.0	1.4	....	....	....	....
Red oak	4″–9″	0.7	0.7	0.5	....	....	....	....
	10″ up	12.4	11.2	7.9	....	....	....	....
White oak	4″–9″	10.2	9.3	6.5	5.6	4.9	3.2	....
	10″ up	23.7	21.7	15.3	4.1	3.6	2.4	....
Poplar (all)	4″–9″	11.4	10.4	7.3	40.2	35.2	23.1	....
	10″ up	19.9	18.2	12.8	45.5	39.9	26.1	....
Black ash	4″–9″	7.2	6.7	4.6	10.6	9.3	6.1	....
	10″ up	0.6	0.5	0.4	1.1	0.9	0.6	....
White ash	4″–9″	1.3	1.2	0.8	2.1	1.8	1.2	....
	10″ up	6.5	6.0	4.2	1.8	1.6	1.0	....
Basswood	4″–9″	1.7	1.6	1.1	2.0	1.7	1.1	....
	10″ up	19.2	17.5	12.3	7.7	6.8	4.5	....
Black cherry	4″–9″	....	....	....	0.7	0.6	0.4	....
	10″ up	....	....	....	1.3	1.1	0.7	....
Butternut	4″–9″	....	....	....	0.5	0.4	0.3	....
	10″ up	....	....	....	1.5	1.3	0.8	....
Hickory	4″–9″	3.7	3.4	2.4	3.7	3.3	2.2	....
	10″ up	6.7	6.1	4.3	2.1	1.8	1.2	....
TOTAL HARDWOODS	4″–9″	115.6	105.9	74.3	180.7	158.1	103.7	....
	10″ up	320.4	292.4	205.5	189.5	165.9	108.6	....
GRAND TOTAL	4″–9″	1184.2	1082.2	759.9	1426.5	1249.2	818.0	....
	10″ up	1426.8	1302.8	915.1	521.5	456.8	299.0	....
TOTAL 4″ UP		2611.0	2385.0	1675.0	1948.0	1706.0	1117.0	....

Table 19 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) Density Class 1	2	3	HARDWOODS ALL-AGED
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	3.1	3.0	2.4	11.8	10.6	7.6	4.7
	10″ up	37.9	36.7	29.9	17.4	15.7	11.1	21.5
White spruce	4″–9″	....	....	....	0.7	0.6	0.5	0.4
	10″ up	....	....	....	0.7	0.6	0.4	0.7
Balsam fir	4″–9″	....	....	....	1.3	1.1	0.9	0.8
	10″ up	....	....	....	0.1	0.1	....	0.1
Hemlock	4″–9″	3.8	3.6	3.0	3.2	2.9	2.0	2.5
	10″ up	9.9	9.6	7.8	5.1	4.6	3.3	8.3
White cedar	4″–9″	8.1	7.9	6.4	21.4	19.3	13.7	8.5
	10″ up	2.8	2.7	2.2	6.4	5.7	4.1	2.7
TOTAL CONIFERS	4″–9″	15.0	14.5	11.8	38.4	34.5	24.7	16.9
	10″ up	50.6	49.0	39.9	29.7	26.7	18.9	33.3
Sugar maple	4″–9″	155.7	150.6	122.7	190.9	171.7	122.3	140.0
	10″ up	823.8	796.3	648.8	73.2	65.8	46.8	228.5
Soft maple	4″–9″	81.8	79.1	64.5	151.2	136.0	96.8	81.0
	10″ up	402.5	389.1	316.9	54.5	49.0	34.9	138.6
White birch	4″–9″	3.0	2.9	2.4	32.1	28.9	20.5	4.7
	10″ up	5.2	5.0	4.1	4.0	3.6	2.6	3.9
Yellow birch	4″–9″	7.4	7.1	5.8	6.0	5.5	3.9	4.0
	10″ up	6.3	6.1	5.0	2.3	2.0	1.4	2.3
Beech	4″–9″	30.6	29.6	24.1	21.2	19.0	13.5	20.8
	10″ up	158.2	152.9	124.6	14.9	13.5	9.6	41.1
Elm	4″–9″	105.0	101.5	82.7	179.7	161.6	115.1	98.7
	10″ up	516.1	498.9	406.5	131.7	118.4	84.3	223.3
Ironwood	4″–9″	21.3	20.6	16.8	23.9	21.5	15.3	11.6
	10″ up	3.3	3.2	2.6	1.1	1.0	0.7	1.6
Red oak	4″–9″	3.0	2.9	2.4	49.0	44.1	31.4	7.3
	10″ up	65.4	63.2	51.5	30.2	27.1	19.3	35.0
White oak	4″–9″	3.7	3.6	2.9	25.4	22.8	16.2	8.8
	10″ up	23.7	22.9	18.6	12.1	11.0	7.8	23.3
Poplar (all)	4″–9″	2.7	2.6	2.1	119.8	107.7	76.7	12.0
	10″ up	16.4	15.9	13.0	31.7	28.5	20.3	15.8
Black ash	4″–9″	11.0	10.6	8.7	20.0	18.0	12.8	9.8
	10″ up	2.7	2.6	2.1	0.9	0.8	0.6	1.2
White ash	4″–9″	9.4	9.1	7.4	31.6	28.4	20.3	10.8
	10″ up	39.8	38.5	31.4	14.3	12.8	9.1	22.8
Basswood	4″–9″	10.7	10.4	8.4	28.9	26.0	18.5	10.5
	10″ up	123.4	119.2	97.2	32.3	29.0	20.7	43.0
Black cherry	4″–9″	2.7	2.6	2.1	10.6	9.6	6.8	2.5
	10″ up	2.8	2.7	2.2	1.9	1.7	1.2	2.4
Butternut	4″–9″	0.2	0.2	0.2	3.1	2.8	2.0	0.9
	10″ up	10.7	10.4	8.4	3.9	3.5	2.5	4.3
Hickory	4″–9″	6.7	6.5	5.3	15.0	13.5	9.6	6.7
	10″ up	15.2	14.7	11.9	4.5	4.0	2.9	8.6
TOTAL HARDWOODS	4″–9″	454.9	439.9	358.5	908.4	817.1	581.7	430.1
	10″ up	2215.5	2141.6	1744.8	413.5	371.7	264.7	795.7
GRAND TOTAL	4″–9″	469.9	454.4	370.3	946.8	851.6	606.4	447.0
	10″ up	2266.1	2190.6	1784.7	443.2	398.4	283.6	829.0
TOTAL 4″ UP		2736.0	2645.0	2155.0	1390.0	1250.0	890.0	1276.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	14.9	14.0	10.4	54.5	46.6	37.5	32.7
	10″ up	192.2	180.5	134.5	62.3	53.2	42.7	110.8
Red pine	4″–9″	....	....	....	2.9	2.5	2.0	0.6
	10″ up	2.7	2.6	1.9	2.0	1.7	1.4	1.9
White spruce	4″–9″	3.4	3.2	2.4	22.4	19.1	15.4	4.7
	10″ up	10.2	9.6	7.1	17.1	14.6	11.7	9.1

Table 19 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Black spruce	4″–9″	....	....	....	3.0	2.5	2.1	0.3
	10″ up	....	....	....	0.3	0.3	0.2	0.3
Balsam fir	4″–9″	11.2	10.5	7.9	35.8	30.6	24.6	13.6
	10″ up	7.9	7.4	5.5	2.0	1.7	1.4	3.5
Hemlock	4″–9″	58.2	54.6	40.7	9.1	7.8	6.3	33.3
	10″ up	192.5	180.8	134.8	10.6	9.1	7.3	61.4
White cedar	4″–9″	188.7	177.2	132.1	297.1	253.8	204.1	178.8
	10″ up	236.4	222.0	165.4	54.9	46.9	37.7	76.2
Red cedar	4″–9″	6.3	5.9	4.4	4.2	3.6	2.9	2.9
	10″ up	4.6	4.3	3.2	0.7	0.6	0.5	1.9
Larch	4″–9″	3.2	3.0	2.3	14.0	12.0	9.6	1.8
	10″ up	2.2	2.1	1.5	2.5	2.1	1.7	1.6
Total Conifers	4″–9″	285.9	268.4	200.2	443.0	378.5	304.5	268.7
	10″ up	648.7	609.3	453.9	152.4	130.2	104.6	266.7
Sugar maple	4″–9″	45.2	42.5	31.6	32.9	28.1	22.6	38.2
	10″ up	240.9	226.2	168.6	16.5	14.1	11.3	64.0
Soft maple	4″–9″	24.4	22.9	17.1	21.1	18.1	14.5	36.8
	10″ up	92.8	87.1	64.9	13.4	11.4	9.2	63.8
White birch	4″–9″	14.6	13.7	10.2	66.6	56.8	45.7	26.6
	10″ up	29.0	27.3	20.3	12.4	10.6	8.5	19.3
Yellow birch	4″–9″	35.6	33.4	24.9	18.9	16.1	13.0	22.0
	10″ up	84.3	79.2	59.0	7.4	6.4	5.1	23.1
Beech	4″–9″	11.5	10.8	8.1	3.3	2.8	2.3	6.1
	10″ up	83.9	78.8	58.7	1.6	1.4	1.1	15.6
Elm	4″–9″	95.7	89.9	67.0	213.5	182.3	146.6	95.2
	10″ up	670.0	629.2	468.9	197.8	168.9	135.9	278.9
Ironwood	4″–9″	8.9	8.4	6.2	7.8	6.6	5.3	9.9
	10″ up	2.0	1.8	1.4	0.4	0.4	0.3	0.7
Red oak	4″–9″	4.3	4.1	3.0	23.5	20.1	16.1	7.1
	10″ up	66.6	62.4	46.6	14.3	12.2	9.9	26.3
White oak	4″–9″	7.4	6.9	5.1	14.4	12.3	9.9	14.5
	10″ up	33.5	31.5	23.5	10.3	8.8	7.0	33.4
Poplar (all)	4″–9″	3.1	2.9	2.2	171.4	146.4	117.7	31.2
	10″ up	26.9	25.3	18.8	123.1	105.1	84.6	74.4
Black ash	4″–9″	25.0	23.5	17.5	29.9	25.5	20.5	20.6
	10″ up	7.7	7.2	5.4	1.4	1.2	1.0	2.6
White ash	4″–9″	6.3	5.9	4.4	7.1	6.0	4.9	4.7
	10″ up	26.4	24.8	18.5	4.4	3.8	3.0	10.4
Basswood	4″–9″	12.4	11.7	8.7	8.1	6.9	5.6	8.9
	10″ up	112.9	106.0	79.0	14.9	12.8	10.2	34.4
Black cherry	4″–9″	4.0	3.7	2.8	2.9	2.5	2.0	1.8
	10″ up	1.5	1.4	1.0	0.4	0.3	0.3	1.6
Butternut	4″–9″	2.1	1.9	1.4	1.0	0.8	0.7	0.7
	10″ up	6.1	5.8	4.3	2.3	2.0	1.6	2.3
Hickory	4″–9″	3.0	2.8	2.1	3.7	3.1	2.5	1.6
	10″ up	2.4	2.3	1.7	2.9	2.5	2.0	2.9
Total Hardwoods	4″–9″	303.5	285.0	212.3	626.1	534.4	429.9	325.9
	10″ up	1486.9	1396.3	1040.6	423.5	361.9	291.0	653.7
GRAND TOTAL	4″–9″	589.4	553.4	412.5	1069.1	912.9	734.4	594.6
	10″ up	2135.6	2005.6	1494.5	575.9	492.1	395.6	920.4
TOTAL 4″ UP		2725.0	2559.0	1907.0	1645.0	1405.0	1130.0	1515.0

Notes

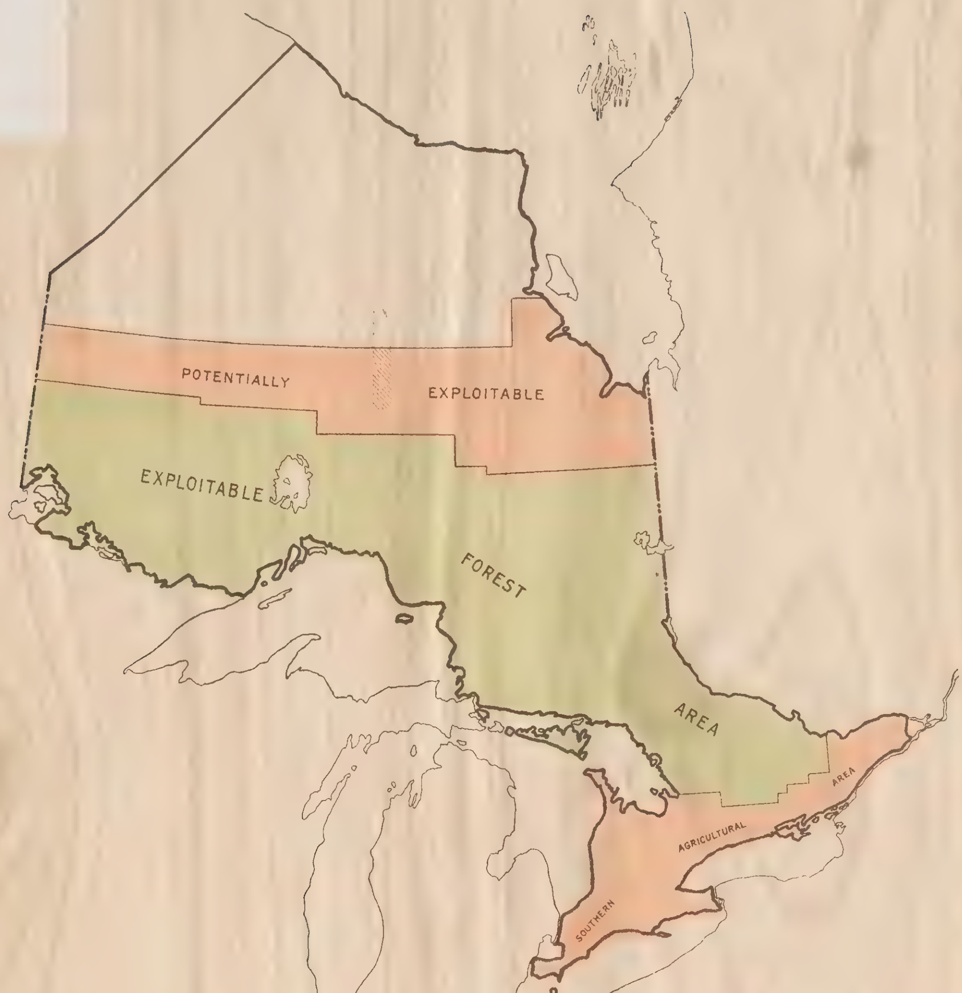
Notes

Hon. G. E. Mapledoram
Minister

F. A. MacDougall
Deputy Minister

Report No. 19 of the

LINDSAY DISTRICT



Forest Resources Inventory

— 1957 —

Division of Timber Management

Ontario Department of Lands and Forests

Forest Resources Inventory

— 1957 —

Report No. 19 of the

LINDSAY DISTRICT

Division of Timber Management

Ontario Department of Lands and Forests

PREFACE

• A large proportion of the earth's land area is covered by forests, which exert an influence, largely beneficial, upon the lives of human beings. Forests reduce soil erosion, regulate stream flow, are a habitat for game, and provide opportunities for recreation. Their prime importance to man, however, is in the production of wood, upon which a wide variety of important industries is based.

Wood, because of its wide distribution and the diverse uses to which it is put, is sometimes known as "the universal raw material." Throughout recorded history wood has been one of the chief sources of fuel. It has been widely used in the construction industry for many years, and the advent of modern adhesives and laminated construction has expanded its uses in this field. Toothpicks, excelsior, toys, furniture, shingles, veneer, plywood, boxes and boats are examples of the wide variety of articles manufactured from wood by secondary industries. Wood distillation produces charcoal and a residue which, through further processing, can be converted into acetic acid, acetic anhydride, acetone, sodium acetate, methyl alcohol and formaldehyde. Chemical utilization has yielded newsprint, writing paper, cartons, paper board, cellophane, rayon and plastics. It has been predicted that wood may eventually replace coal and petroleum as a source of industrial chemicals.

Forests, despite their many benefits and a constantly increasing demand for their products, are being continually destroyed. When it becomes apparent that the forest resource is being depleted, with critical effects upon the supply of products and services, the need for conservation is recognized. Fortunately, forests are renewable, although their restoration may require a considerable period of time. Since 1946, the Department of Lands and Forests has been engaged in a province-wide survey to determine the present status of our forest resources.

The extension of this survey to include the southern agricultural areas was authorized in 1952, and work was started by the Division of Timber Management early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Department of Lands and Forests has established twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the nineteenth in the series, deals with the results of the inventory in the Lindsay district.

CONTENTS

FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Lindsay district, excluding 5,408 acres administered by the Federal Government, is 3,333,492 acres, or 5,209 square miles. Inland waters cover 259,844 acres, or 8 per cent of this area.

2. The total land area of the district, including Federal lands, is 3,079,056 acres. Forested areas cover 54.3 per cent of this area and 43.4 per cent is devoted to agriculture. The remaining 2.3 per cent is classified as other areas, which include such areas as Federal lands, towns, cities, roads, power lines, gravel-pits and railroads.

3. The forested land has been classified as 89 per cent productive and 11 per cent non-productive. Agricultural areas are composed of 65 per cent developed agricultural land, 28 per cent grass and meadow land, and 7 per cent wooded pasture.

4. Thirty-five per cent of the productive forest land is owned by the Crown. For the purposes of this report, Municipal, County, and Authority Forests, which are administered under an agreement with the Minister of Lands and Forests, are classed as Crown land.

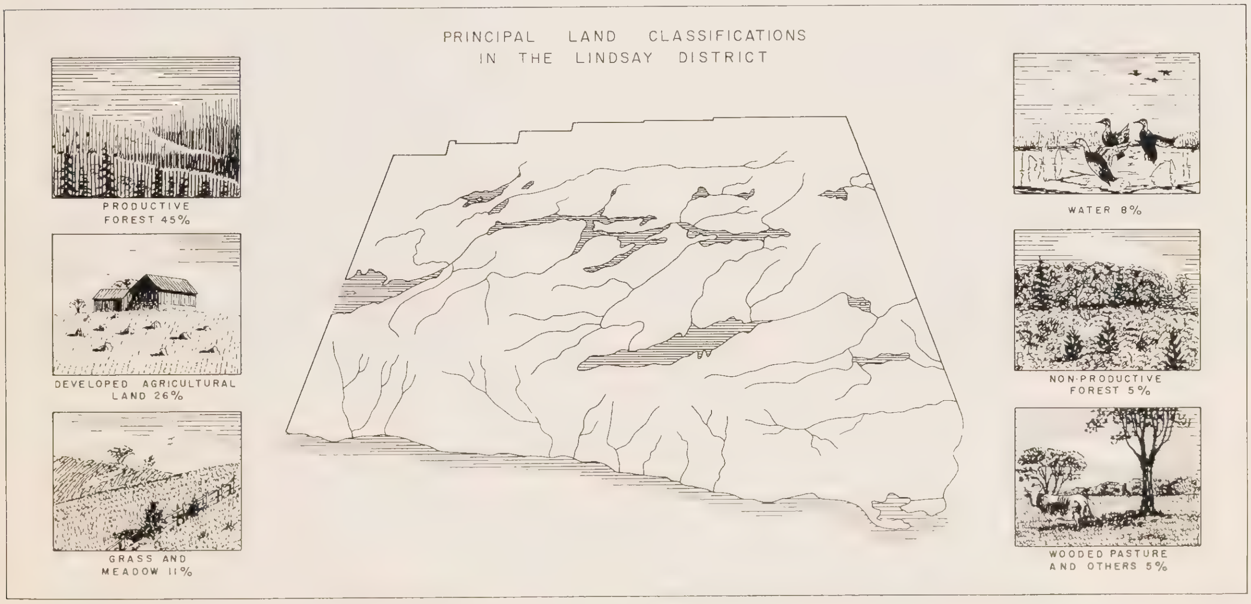
5. The age class distribution on productive forest lands shows: 10 per cent mature, 76 per cent immature, 3 per cent all-aged, 9 per cent young growth, and 2 per cent reproducing forest.

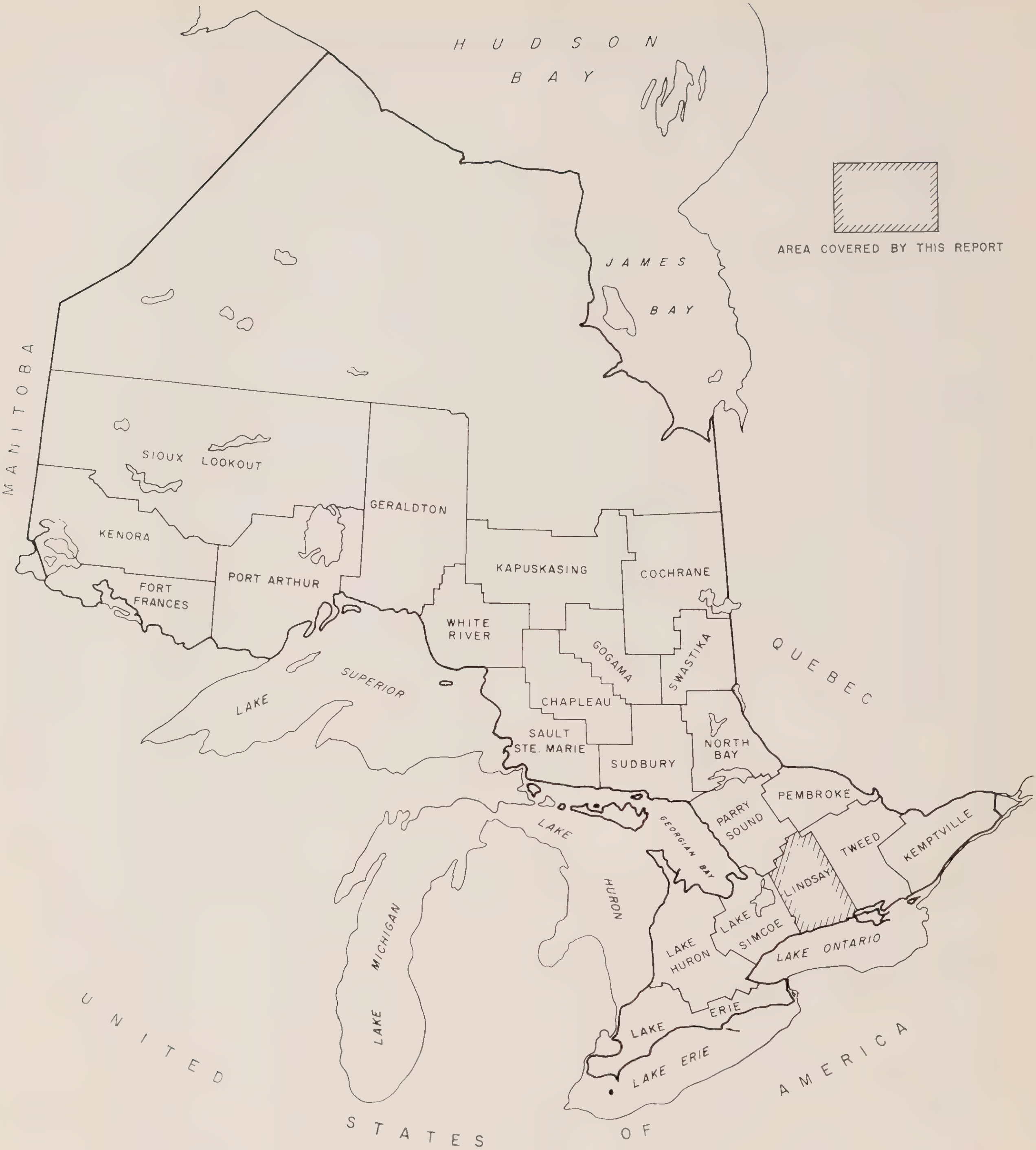
6. The hardwood cover type occupies 60 per cent of the productive forest area; the mixedwoods type occupies 30 per cent, and the coniferous type only 10 per cent.

7. The primary growing stock in the Lindsay district is just under two billion cubic feet and averages 1,342 cubic feet per acre. Hardwoods comprise 74 per cent of the total volume. The immature age class contains 77 per cent of the primary growing stock.

8. The annual allowable cut, or total depletion permissible under sustained yield management for the Lindsay district, is 38.6 million cubic feet. Hardwood species make up 80 per cent of the allowable cut.

9. A comparison of the actual utilization on Crown lands with the allowable cut indicates that four times the permissible cut for the coniferous species is being taken, while only 40 per cent of the hardwood allowable cut is being used. Red and white pine, hemlock, and the two spruces are all being heavily overcut.





MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Town of Lindsay, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Historical Background

• Settlement along the north shore of Lake Ontario was hindered during the French Regime, because of danger from the Iroquois. Shortly after the area came under British control, settlement began with an influx of loyalists following the American Revolution. The first real impetus to settlement was the Constitutional Act of 1791. A later wave of settlement occurred between 1815 and 1820, while a further influx of pioneers into Upper Canada followed the rebellion of 1837.

Early colonization took place at the river mouths, while at a later period villages grew up along the rivers where there was sufficient waterpower to operate the mills. The pioneers cleared the forest to provide land for agriculture. Forest products were utilized directly by the settlers for buildings, fuel, fencing, household utensils and implements. Masting for the Royal Navy was the earliest timber exported. This utilized only the finest white pine. At a later date, the square timber trade flourished; first, with a stick squared on four sides, and later, with "waney" timber (a stick squared, but with rounded shoulders). The earliest lumber was provided by pit-sawing. This was superseded by waterpower mills which used a vertical saw until about 1850, when it was succeeded by the circular saw.

Licenses to cut Crown timber in what is now the Province of Ontario were first issued in 1828. The sawmilling industry expanded rapidly after the opening of the American market around 1840, and the further impetus of the Reciprocity Treaty of 1854. Railroads were constructed northward to extend the supply area. By 1854, Cobourg and Peterborough were linked by rail. This was extended to Lindsay by 1870, and eight years later to Haliburton. Toronto was connected to Coboconk by rail in 1872; and Whitby to Port Perry and Lindsay by 1877. As this area, containing a magnificent pinery, was tapped, sawmills sprang up along the railroad and the shipment of lumber to the lake ports greatly increased.

The volume of white pine cut on the Trent watershed alone in 1872–73 was 117 million board feet. After 1910 the cut of pine steadily declined, and the use of portable, or steam, mills became common. In 1911–12 just over 10 million board feet was cut, and by 1954–5 the entire Lindsay district produced slightly less than 3 million board feet of red and white pine.

Although the British established forest reserves to ensure the supply of timber, this policy, unfortunately, was not implemented in Canada. As early as 1854 it was recognized that the supply of pine was not inexhaustible, and that the continued settlement of low-quality agricultural soils was unwise.

When the timber supply was exhausted, the industries either moved on to new areas or ceased to exist. The fertility of the cleared land was rapidly depleted, and farms were abandoned. The original pine forests had largely disappeared, while repeated fires produced either a poplar-birch forest or a rock barren. At a later date operations removed the more valuable hardwoods, leaving a hardwood-mixedwoods forest of inferior species.

The rehabilitation of such an area will require an investment of time and money in the preparation and implementation of forest management plans, to ensure a sustained yield of valuable forest products. Initial steps have already been taken, on the best and most accessible sites, to improve the forests of this district. Mature trees are harvested in a way designed to protect the soil on cut-overs against detrimental factors, and to provide conditions favourable to natural regeneration. Immature stands of valuable species are cleaned, released, or thinned, depending upon age and condition, to stimulate quality production. Where past operations have removed the seed supply, the areas are planted to the desired species.

Areas

The total area of the Lindsay district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 3,333,492 acres (table 1), 5,209 square miles. This area is surveyed into 60 townships, which comprise all, or parts of, five counties. Within the district, inland waters, excluding Lake Ontario, cover an area of 259,844 acres, or 8 per cent of the total area, leaving a net land area of 3,073,648 acres. Productive forest lands occupy 1,489,671 acres, or 45 per cent of the total area (fig. 1).

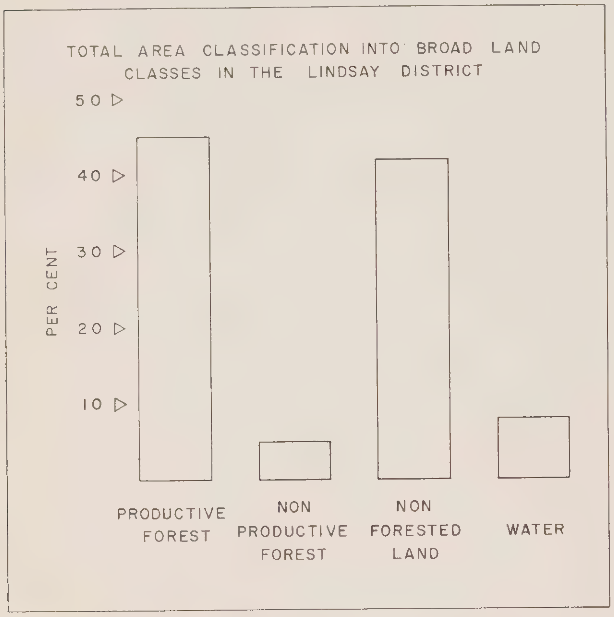


FIGURE 1

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	526,589	963,082	1,489,671
Non-forested land[2]			
Developed agricultural land	888	863,258	864,146
Grass and meadow land	3,314	369,358	372,672
Non-reproducing burn	476	....	476
Wooded pasture	174	100,130	100,304
Unclassified land[3]	2,177	61,942	64,119
TOTAL	7,029	1,394,688	1,401,717
Non-productive forest[4]			
Open muskeg	5,988	21,780	27,768
Treed muskeg (scrub)	672	1,094	1,766
Brush, alder and flooded land	33,682	86,248	119,930
Rock outcrop	23,004	9,792	32,796
TOTAL	63,346	118,914	182,260
Water	259,844	....	259,844
TOTAL AREA	856,808	2,476,684	3,333,492

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

[2] Productive forest lands permanently withdrawn from timber production use.

[3] Lands occupied by roads, railroads, towns, etc.

[4] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity.

Non-productive forest lands which, because of very low productivity, appear to be permanently unfit for commercial timber production occupy 5 per cent of

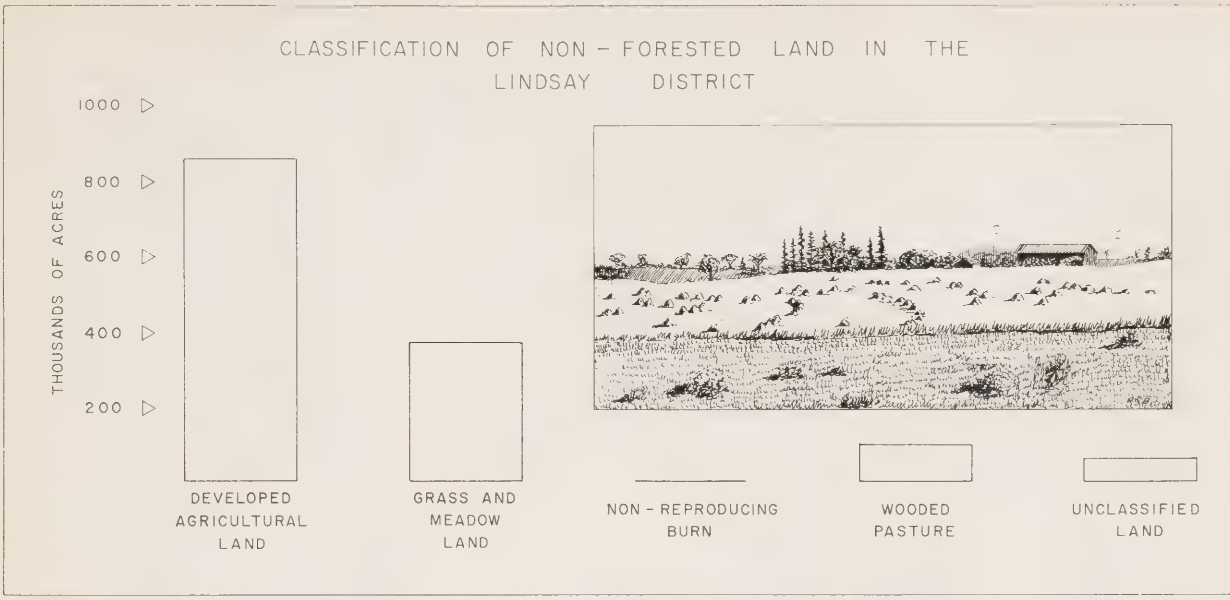


FIGURE 2

the total area. Non-forested lands, which include areas permanently withdrawn from timber production, form 42 per cent of the total area. The principal areas within this classification are 864,146 acres of developed agricultural land and 372,672 acres of grass and meadow land (fig. 2). There are 100,304 acres of low-density stands, often comprised of a few large open-grown trees with wide-spreading crowns, classed as wooded pasture. These occur within the predominantly agricultural portion of the district and are generally quite heavily grazed. In addition, there are 476 acres of non-reproducing burn and 64,119 acres of unclassified land occupied by cities, towns, villages, roads, railways, power lines, gravel-pits or otherwise withdrawn from forest production.

An analysis of the principal land classifications by townships and counties indicates that the productive forest land is concentrated in Haliburton County and the northern townships of Peterborough County (table 2). In the counties of Durham and Northumberland it comprises only about 18 per cent of the total land area. Productive forest land ranges from a low of 9 per cent in Ops Township to a high of 96 per cent in Havelock Township (fig. 3).

Non-productive forest lands occupy a relatively small area in the Lindsay district. The greatest areas occur in Victoria County, where they comprise nearly 11 per cent of the land area. This classification forms nearly 43 per cent of Dalton, 30 per cent of Digby, 15 per cent of Cardon and 11 per cent of Laxton and Longford Townships.

Agricultural land is concentrated in the southernmost counties of Durham and Northumberland, where it occupies 76 and 73 per cent, respectively, of the total land area. Victoria County has 56 per cent of the land area devoted to agriculture, Peterborough County 33 per cent, and Haliburton County just under 9 per cent.

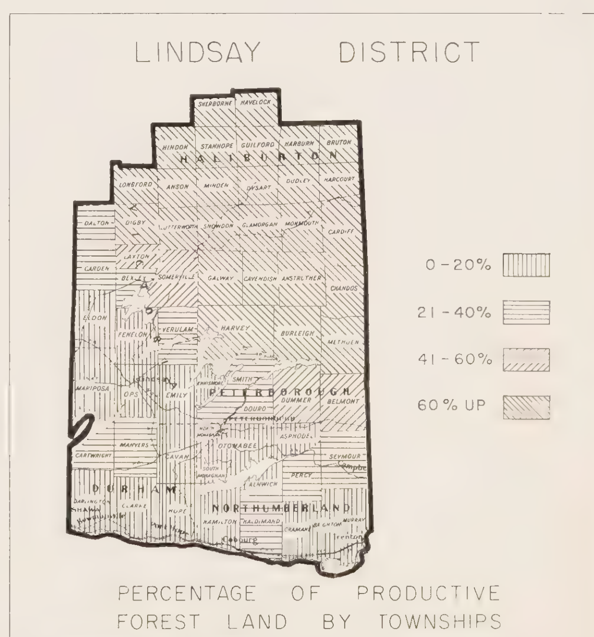


FIGURE 3

TABLE 2. — *Principal land classifications by townships and counties — Lindsay district.*

Township and county	Total area	Total land area	Forested land				Agricultural land						Other areas[2]	
			Productive		Non-productive		Developed agricultural land		Grass and meadow		Wooded pasture[1]			
	acres	acres	acres	percent	acres	percent	acres	percent	acres	percent	acres	percent	acres	percent
Cartwright	42,558	39,036	9,054	23.2	2,008	5.2	19,550	50.1	6,720	17.2	750	1.9	954	2.4
Cavan	66,298	65,912	12,171	18.5	1,757	2.7	30,730	46.6	15,752	23.9	3,502	5.3	2,000	3.0
Clarke	74,152	73,876	13,050	17.7	301	0.4	31,692	42.9	20,360	27.5	5,600	7.6	2,873	3.9
Darlington	74,758	73,984	7,186	9.7	702	1.0	41,486	56.1	15,196	20.5	4,834	6.5	4,580	6.2
Hope	67,788	67,172	10,499	15.6	566	0.9	31,444	46.8	15,832	23.6	5,658	8.4	3,173	4.7
Manvers	72,740	71,966	17,763	24.7	3,201	4.5	29,518	41.0	16,328	22.7	3,118	4.3	2,038	2.8
DURHAM COUNTY	398,294	391,946	69,723	17.8	8,535	2.2	184,420	47.0	90,188	23.0	23,462	6.0	15,618	4.0
Anson	42,044	40,424	34,732	85.9	2,400	6.0	2,758	6.8	448	1.1	...	...	86	0.2
Bruton	43,328	41,366	39,768	96.2	1,456	3.5	...	...	134	0.3	...	...	8	...
Cardiff	75,442	68,378	57,408	83.9	3,256	4.8	5,240	7.7	1,994	2.9	...	...	480	0.7
Dudley	44,106	38,550	36,316	94.2	1,708	4.4	94	0.2	402	1.1	...	...	30	0.1
Dysart	43,808	40,948	33,686	82.3	1,596	3.9	3,138	7.7	1,978	4.8	...	...	550	1.3
Glamorgan	55,414	50,850	43,466	85.5	3,016	5.9	840	1.6	3,196	6.3	...	...	332	0.7
Guilford	47,068	39,704	35,264	88.9	964	2.4	2,032	5.1	682	1.7	...	...	762	1.9
Harburn	44,842	38,556	36,598	94.9	1,004	2.6	350	0.9	132	0.4	...	...	472	1.2
Harcourt	39,058	32,504	30,544	94.0	1,084	3.3	460	1.4	258	0.8	...	...	158	0.5
Havelock	35,280	28,196	27,192	96.4	948	3.4	...	...	...	...	...	...	56	0.2
Hindon	45,808	43,354	39,276	90.6	3,554	8.2	66	0.2	356	0.8	...	...	102	0.2
Lutterworth	46,428	41,376	34,730	83.9	1,466	3.5	1,992	4.8	2,878	7.0	...	...	310	0.8
Minden	46,456	40,520	27,258	67.3	1,200	3.0	7,928	19.5	3,602	8.9	...	...	532	1.3
Monmouth	56,768	53,976	44,898	83.2	2,270	4.2	3,000	5.6	2,984	5.6	...	...	824	1.4
Sherborne	28,838	23,966	23,008	96.0	894	3.7	14	0.1	4	...	...	...	46	0.2
Snowdon	53,676	52,382	38,600	73.7	3,950	7.5	5,364	10.3	4,196	8.0	...	...	272	0.5
Stanhope	48,758	39,878	32,170	80.7	1,676	4.2	3,840	9.6	1,790	4.5	...	...	402	1.0
HALIBURTON COUNTY	797,122	714,928	614,914	86.0	32,442	4.5	37,116	5.2	25,034	3.5	...	...	5,422	0.8
Alnwich	26,810	20,832	3,104	14.9	656	3.2	9,002	43.2	3,856	18.5	420	2.0	3,794	18.2
Brighton	55,016	54,480	10,514	19.3	4,886	9.0	24,864	45.6	9,722	17.9	2,514	4.6	1,980	3.6
Cramake	49,594	49,358	9,970	20.2	876	1.8	27,026	54.8	8,156	16.5	1,734	3.5	1,596	3.2
Haldimand	79,756	79,714	20,304	25.5	1,059	1.3	35,054	44.0	18,320	23.0	2,502	3.1	2,475	3.1
Hamilton	77,080	67,730	6,524	9.6	923	1.4	34,958	51.6	18,644	27.5	2,472	3.7	4,209	6.2
Murray	53,258	52,424	9,220	17.6	4,930	9.4	24,516	46.8	9,258	17.6	2,676	5.1	1,824	3.5
Percy	54,314	53,016	10,986	20.7	1,038	1.9	29,616	55.9	8,256	15.6	1,762	3.3	1,358	2.6
Seymour	45,138	41,284	8,770	21.3	2,386	5.8	19,338	46.8	7,140	17.3	2,772	6.7	878	2.1
South Monaghan	20,478	19,324	2,324	12.0	1,406	7.3	11,018	57.0	3,376	17.5	792	4.1	408	2.1
NORTHUMBERLAND COUNTY	461,384	438,162	81,716	18.6	18,160	4.2	215,392	49.2	86,728	19.8	17,644	4.0	18,522	4.2
Anstruther	74,384	68,508	59,098	86.3	6,892	10.1	1,266	1.8	922	1.3	...	...	330	0.5
Asphodel	40,904	39,952	7,188	18.0	2,822	7.1	23,202	58.1	4,922	12.3	598	1.5	1,220	3.0
Belmont	74,418	69,232	41,670	60.2	3,772	5.4	10,500	15.2	9,810	14.2	2,592	3.7	888	1.3
Burleigh	76,686	68,458	57,480	84.0	6,314	9.2	2,568	3.7	1,756	2.6	...	...	340	0.5
Cavendish	54,608	48,128	44,358	92.2	2,524	5.2	80	0.2	956	2.0	...	...	210	0.4
Chandos	57,464	52,388	40,100	76.5	1,558	3.0	5,862	11.2	4,348	8.3	...	...	520	1.0
Douro	42,004	40,266	8,618	21.4	2,096	5.2	20,556	51.1	5,632	14.0	2,018	5.0	1,346	3.3
Dummer	78,070	73,212	37,062	50.6	2,022	2.8	19,254	26.3	10,184	13.9	3,892	5.3	798	1.1
Ennismore	22,746	18,752	3,102	16.6	962	5.1	10,102	53.9	2,794	14.9	1,490	7.9	302	1.6
Galway	70,914	67,712	56,140	82.9	2,774	4.1	5,670	8.4	2,900	4.3	...	...	228	0.3
Harvey	114,802	97,430	72,132	74.0	4,968	5.1	11,360	11.7	7,584	7.8	516	0.5	870	0.9
Methuen	71,944	64,138	56,266	87.7	5,634	8.8	1,408	2.2	502	0.8	...	...	328	0.5
North Monaghan	16,070	15,768	1,908	12.1	1,018	6.5	6,244	39.6	2,748	17.4	404	2.6	3,446	21.8
Otonabee	78,398	71,190	10,218	14.4	4,778	6.7	40,812	57.3	9,436	13.3	1,718	2.4	4,228	5.9
Smith	73,290	61,788	15,412	24.9	1,920	3.1	32,564	52.8	6,326	10.2	3,718	6.0	1,848	3.0
PETERBOROUGH COUNTY	946,702	856,922	510,752	59.6	50,054	5.8	191,448	22.3	70,820	8.3	16,946	2.0	16,902	2.0

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture[1]		Other areas[2]	
	acres	*acres*	*acres*	*percent*	*acres*	*percent*	*acres*	*percent*	*acres*	*percent*	*acres*	*percent*	*acres*	*percent*
Bexley	37,240	29,476	11,854	40.2	1,204	4.1	2,582	8.8	9,280	31.5	3,802	12.9	754	2.5
Carden	49,482	45,868	10,480	22.8	6,710	14.6	3,904	8.5	16,962	37.0	7,138	15.6	674	1.5
Dalton	42,210	41,130	15,292	37.2	17,538	42.6	2,834	6.9	2,538	6.2	2,670	6.5	258	0.6
Digby	51,210	48,880	31,898	65.3	14,524	29.7	1,278	2.6	714	1.5	392	0.8	74	0.1
Eldon	65,624	63,542	8,950	14.1	2,822	4.4	28,382	44.7	16,396	25.8	5,702	9.0	1,290	2.0
Emily	64,538	60,660	8,068	13.3	4,945	8.1	32,492	53.6	9,096	15.0	4,652	7.7	1,407	2.3
Fenelon	68,420	55,134	11,098	20.1	3,914	7.1	25,466	46.2	9,474	17.2	3,468	6.3	1,714	3.1
Laxton	28,386	25,212	11,218	44.5	2,858	11.3	3,006	11.9	4,398	17.4	2,888	11.5	844	3.4
Longford	43,040	39,002	34,518	88.5	4,254	10.9	58	0.2	158	0.4	....	....	14	....
Mariposa	83,338	77,136	8,382	10.9	4,820	6.2	51,018	66.1	8,024	10.4	3,294	4.3	1,598	2.1
Ops	62,974	61,398	5,736	9.4	5,642	9.2	37,648	61.3	6,900	11.2	2,718	4.4	2,754	4.5
Somerville	74,204	69,834	39,422	56.5	1,970	2.8	13,278	19.0	11,514	16.5	2,618	3.7	1,032	1.5
Verulam	64,732	59,826	15,650	26.2	1,868	3.1	33,824	56.5	4,448	7.4	2,910	4.9	1,126	1.9
VICTORIA COUNTY	735,398	677,098	212,566	31.4	73,069	10.8	235,770	34.8	99,902	14.8	42,252	6.2	13,539	2.0
TOTAL, LINDSAY DISTRICT	3,338,900[3]	3,079,056[3]	1,489,671	48.4	182,260	5.9	864,146	28.1	372,672	12.1	100,304	3.2	70,003[3]	2.3

[1] This classification was used only for that portion of the district covered by mosaics. See figure 7, Huron Section.

[2] Other areas include all land administered by the Federal Government, and roads, railways, villages, towns, cities, gravel-pits, etc.

[3] These totals include land areas administered by the Federal Government.

Forest Land Ownership

Forest lands, in Ontario, have generally been retained under public ownership, and the right to cut and remove timber from them has been granted by a licence. Lands suitable for agriculture have been opened for settlement, and lands have been granted or sold under the various land settlement regulations which have been in force from time to time. Lands are also patented for mining purposes, summer resorts and other uses. All of these various types of ownership are grouped under "patented lands," which include all lands owned privately, in contrast to Crown lands.

It has been the usual practice in this province to reserve all pine timber to the Crown at the time patent is issued, while on some lands patented for mining all timber is reserved to the Crown. The ownership of timber on privately owned lands presents an exceedingly complicated subject, and in establishing an ownership classification for inventory no attempt has been made to segregate these various groups. All recorded patented land is treated as such, whether or not timber rights are vested in the Crown.

Patented land totals 2,476,684 acres, or 74 per cent of the total area of the Lindsay district, while 856,808 acres, or 26 per cent is retained in Crown ownership (fig. 4). If only the productive forest land area of 1,489,671 acres is considered, 65 per cent is patented land and 35 per cent is Crown land. Patented land is further classified on a township basis into townships containing less than 10 per cent patented land; those containing between 10 and 50

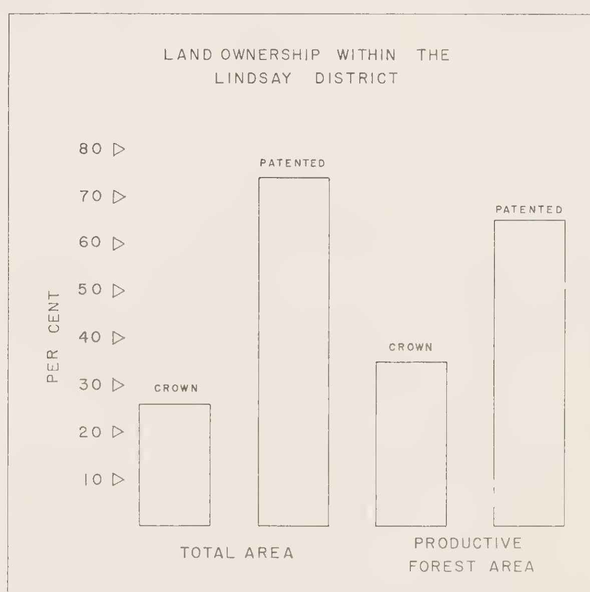
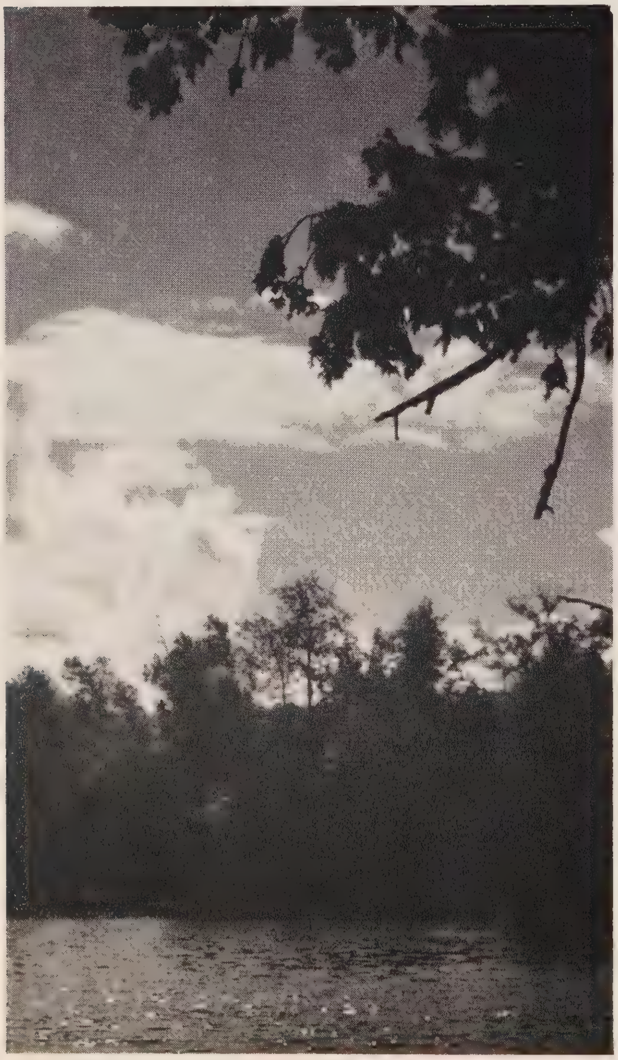


FIGURE 4

per cent patented land, and townships over 50 per cent patented land (fig. 5).

Under the terms of legislation of the Forestry Act (Stat. 1952, chap. 32), the Minister of Lands and Forests may enter into an agreement with the owners of lands that are suitable for forestry purposes for the reforestation and management of such lands for a stated period of years which must not be less than twenty years. Areas for which such an agreement has been made are, for the purposes of this report, included with Crown lands.

Municipalities may, under the terms of The Trees Act (R.S.O. 1950, chap. 399), purchase land and either place the responsibility of reforestation and management in the hands of the Province through co-operative agreements, or carry out the planting and management of the forests without an agreement.



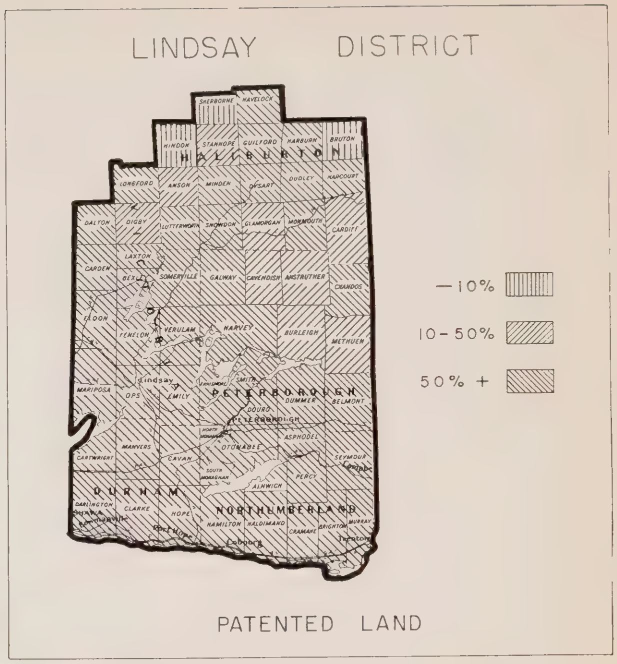


FIGURE 5

The agreement provides that the Province will assume the responsibility for re-establishment and care of the forest for a stated period of years, usually fifty in recent agreements. At the end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price. Within the Lindsay district, four municipalities have forests under agreement with the Crown: the Victoria County Forest of 7,025 acres, the Northumberland County Forest of 3,700 acres, the Durham County Forest of 1,409 acres, and the Galway Township Forest of 600 acres.

The Conservation Authorities Act (R.S.O. 1950, chap. 62) permits the authority to enter into an agreement with the Minister of Lands and Forests for the administration of Authority Forests. These agreements are similar, although not identical, to those entered into by the municipalities and the Crown. The Ganaraska River Conservation Authority was established in 1946, and the Ganaraska Forest is administered under an agreement. This forest now covers 7,087 acres, of which 3,500 acres have been planted, while most of the remainder had natural woodlot on it when purchased.

The Lindsay district contains a provincial forest tree nursery which was established at Orono in 1922. This now comprises 858 acres devoted to seed beds, transplant compartments, demonstration plantations, natural woodland areas, a public park, and administrative buildings.

Age Classes

To produce sustained timber yields, a forest should be composed of trees of all age classes and stages of development from seedlings to mature timber, in such proportions that when one group of trees is harvested another is ready to take its place.

Of the total productive forest area, 154,983 acres, or 10 per cent, is mature; 1,134,393 acres, or 76 per cent, is immature; 43,005 acres, or 3 per cent, is all-aged; 133,604 acres, or 9 per cent, is young growth; and only 23,686 acres, or 2 per cent, is classed as reproducing forest (table 3, fig. 6).

Patented land, totalling 963,082 acres, has 10 per cent mature, 75 per cent immature, 4 per cent all-aged, 9 per cent young growth and 2 per cent reproducing forest.

On Crown lands, mature forest occupies 11 per cent of the area; immature, 77 per cent; young growth, 10 per cent; and reproducing forest, 2 per cent. The all-aged classification was used only in the southern agricultural portion of the district, which falls mainly under patented ownership, thus only 281 acres of Crown land occur within this category.

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	4,979	10,750	15,729	1
Hardwood	44,130	68,818	112,948	7
Mixedwoods	7,656	18,650	26,306	2
TOTAL	56,765	98,218	154,983	10
Immature forest:				
Coniferous	33,445	68,954	102,399	7
Hardwood	239,657	426,716	666,373	45
Mixedwoods	134,769	230,852	365,621	24
TOTAL	407,871	726,522	1,134,393	76
All-aged forest:				
Hardwood	76	20,490	20,566	1
Mixedwoods	205	22,234	22,439	2
TOTAL	281	42,724	43,005	3
Young growth:				
Coniferous	962	7,736	8,698	1
Hardwood	47,220	45,330	92,550	6
Mixedwoods	4,216	28,140	32,356	2
TOTAL	52,398	81,206	133,604	9
Reproducing forest	9,274	14,412	23,686	2
TOTAL PRODUCTIVE FOREST	526,589	963,082	1,489,671	100

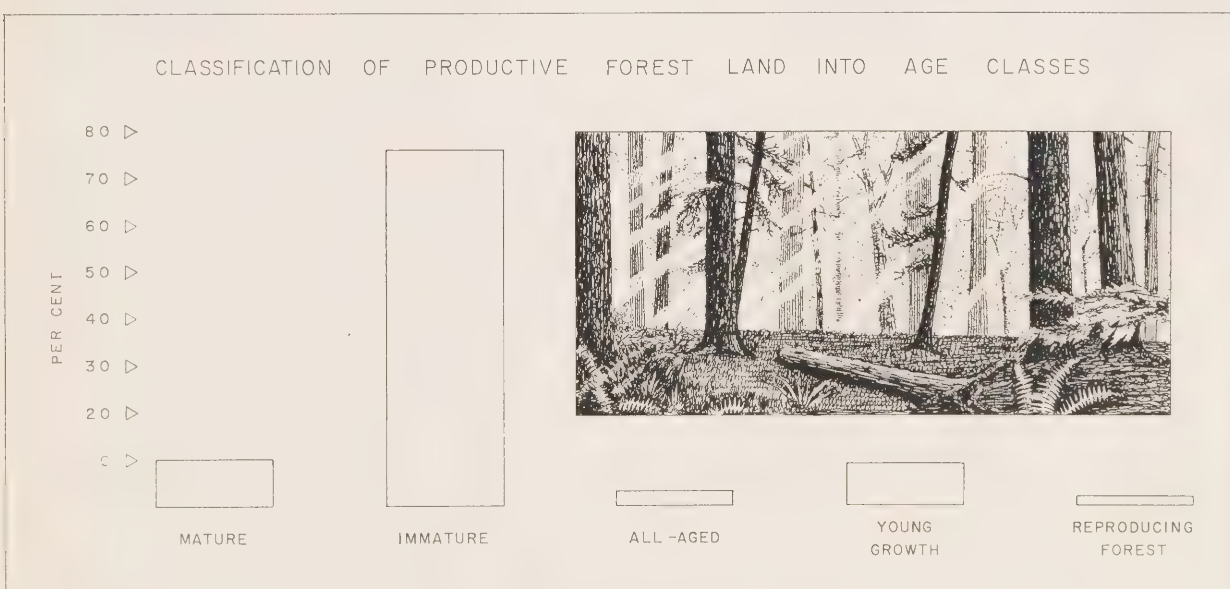


FIGURE 6

Regional Forest Types

The Lindsay district lies within the Great Lakes-St. Lawrence forest region, in which sugar maple and yellow birch are the indicating species. White pine and red maple are widespread throughout most of the region, while hemlock and beech have a more restricted distribution. Within this region, local climatic conditions and soil and rock formations have combined to form a broad uniformity of tree species.

Separate volume and yield tables are prepared for each region, or section, and they serve as units in the compilation of volume estimates. Two forest sections occur within the Lindsay district (fig. 7), as follows:

1. The Algonquin section in the northern part of the district covers 48 per cent of the total area.

2. The Huron section covers 52 per cent of the total area and is located in the south of the district.

The Algonquin section occupies the southern portion of the Precambrian Shield, and has a bed-rock composed of crystalline limestone, schists and gneisses. The topography is rough and irregular with innumerable lakes and streams. Within the Lindsay district this area supports a large tourist industry. The extensive pine forests have largely disappeared, to be replaced by secondary associations of aspen, white birch, balsam fir, white spruce, red and white pine, red maple, red oak and ironwood. A mixed forest of sugar maple, hemlock, yellow birch and white pine is prevalent.

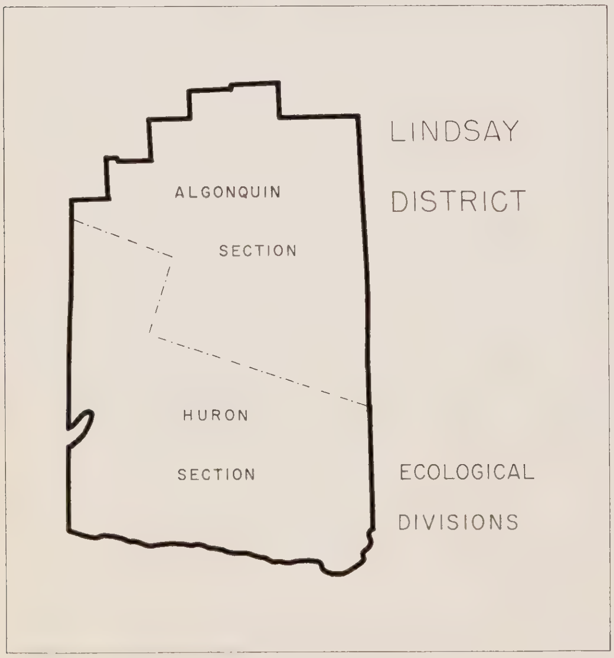


FIGURE 7

The Huron section is underlain by Ordovician limestone, largely of the Trenton-Black River group. This rock is overlain by glacial deposits, which are, in part, modified by wave action and lacustrine deposits. A broad-leaved forest in which beech and sugar maple are dominant is the prevailing association. Basswood, white elm, yellow birch, white ash, red maple, and red, white and bur oak are also present. Other species, both coniferous and hardwood, have a scattered representation. Specialized sites, such as swamps, support white cedar or a swamp hardwood type composed of black ash, white elm and silver maple. Since the section is well-settled and considerably cleared, the forest is restricted to farm woodlots, swampy, and waste lands. This section has been divided into minor physiographic regions[1] as follows (fig. 8):

1. *Carden Plain.* — This area of limestone plain, with very little overburden, extends between the Kawartha Lakes and Lake Couchiching. Population and occupied farms have decreased with the decline of the lumbering industry. More than 60 per cent of the occupied land is rough pasture, largely used as range for beef cattle.

2. *Simcoe Lowlands.* — These are part of the Lake Simcoe basin and are formed of sand, silt and clay. They show considerable variation, but the general characteristic is poor drainage, which is detrimental to general farming.

3. *Peterborough Drumlin Field.* — The City of Peterborough occupies the geographic centre of this area, and there the drumlins are most typical in form and most densely distributed. The highly fossiliferous and easily disintegrated Trenton limestone underlies this region. In general, the drumlins are oriented from northeast to southwest. This area is also notable for its eskers, which are a valuable source of gravel. A great variety of soil types occurs in this region. Utilization of the land is handicapped by stoniness, steep slopes, and wet, swampy hollows. It is an area of generalized agriculture.

4. *Dummer Moraines.* — The sedimentary limestones form a rough, stony plain bordering the Precambrian Shield and sloping gently to the south.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951.

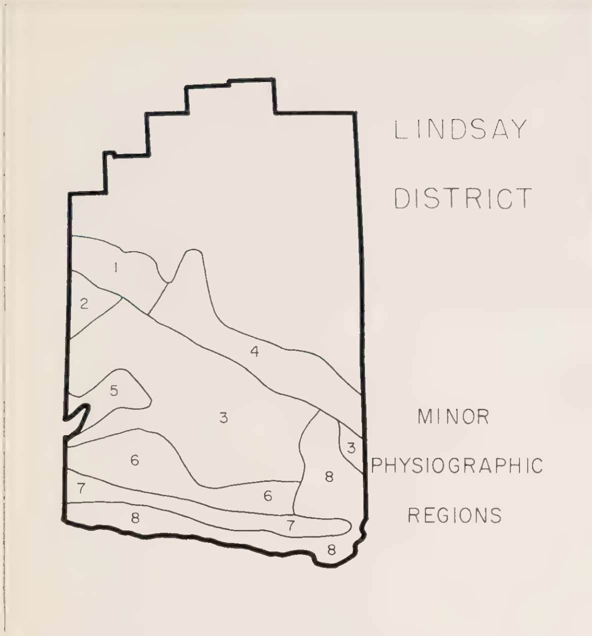


FIGURE 8

Angular fragments of limestone and Precambrian rocks are characteristic of this area. Despite the limitations of stoniness and drought, a large proportion of this area has been cleared for agriculture.

5. *Schomberg Clay Plains.* — Deep deposits of stratified clay and silt overlie a flat till plain to the north of Lake Scugog. These plains have been thoroughly cleared, and little forest remains except in the wettest places. Mixed farming is the rule, with a dominance of grain on the crop land. The area supports both good beef cattle and good dairy herds.

6. *Oak Ridges.* — With a general altitude of 1,000 feet above sea-level, and extending from the Trent River to the Niagara Escarpment, this ridge forms the height of land between the Ontario drainage basin and those streams draining into the Trent River and into Georgian Bay. In general, the hills are formed of sandy or gravelly material. Water drains vertically through the sand and gravel and, although the source of many streams, there is a virtual lack of streams within much of the moraine. The original vegetation was pine and hardwoods. The characteristic soil is unstable under cultivation, or even under pasture, and the hilly sandy soil is subject to blowing. Forests at Vivian, Pontypool and Fenella provide a splendid demonstration of the effectiveness of reforestation in stabilizing these soils.

7. *South Slope.* — This is the southern slope of the interlobate moraine, and averages six to seven miles in width. Streams have cut deep valleys in the till. Active erosion and the extension of gullies is a critical problem in this high-quality land. In Durham County, there are long, thin drumlins pointing up the slope. The slope in Northumberland County is thickly covered by large drumlins pointing to the southwest. A marly clay till is found in Durham, while in Northumberland fine sand and silt cover the till to a depth of six or eight feet.

8. *Iroquois Plain.* — This region borders Lake Ontario and varies in width from a few hundred yards to some eight miles. Flooded in late Pleistocene times by Lake Iroquois, it contains diverse conditions and has thus been divided into subsections. The Trent embayment occurs in the eastern part of the district and consists of drumlin hills crowned by boulder pavements. Various lacustrine deposits occur in the lowlands. The section from Scarborough to Trenton — the eastern portion of which occurs in this district — is a complex area not readily divisible into convenient geographic units. Drumlins and clay plains extend across Durham County, becoming more rugged east of Newcastle. A plain with deep loamy soils planted to apple orchards occurs around Bowmanville and Newcastle. The Ganaraska River and its branches formed a sand plain near Port Hope, which is a tobacco-growing area. The old shoreline north of Port Hope and Cobourg is much indented, and the debris from the eroded drumlins formed a dry terrace cut at intervals by deep-stream valleys. Eastward from Cobourg the plain is about three and a half miles wide and has a peculiar belted pattern. The fine sands and silts support general farming, fruit and canning crops, while the clay loams are utilized for canning peas and tomatoes, in addition to grains and clovers.

Cover Types

The inventory of the Lindsay district has recognized 25 native species, or species groups, occurring in sufficient volume to be incorporated in this report. In addition, four species — Scots pine, Carolina poplar, European larch and black locust — have been introduced in plantations within the district. Nine species comprise 76 per cent of the total wood volume. Twenty-three per cent is contributed by sugar maple, 14 per cent by poplar, 8 per cent by white cedar, 7 per cent each by elm and white pine, 5 per cent by

white birch, and 4 per cent each by yellow birch, red oak and beech.

The forests of the district are described under three main cover types: coniferous, hardwood, and mixed-woods. The coniferous type is one in which 75 per cent or more of the number of trees are conifers or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or broadleaved trees. All other combinations are classed as mixed-woods. In addition to the three main cover types, there are small areas of natural reproduction too recently established to have attained a sufficiently stable composition to be classified into cover types. The plantations are areas of artificially established reproduction which have been classified according to cover type.

The hardwood type occupies 60 per cent of the productive forest land (table 4); the mixedwoods type covers 30 per cent, and the coniferous type only 10 per cent (fig. 9).

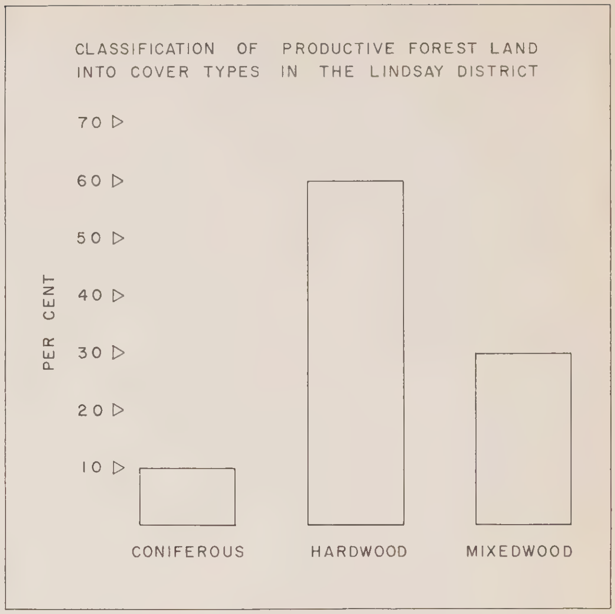


FIGURE 9

TABLE 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	4,979	1	10,750	1	15,729	1
Immature	33,445	7	68,954	7	102,399	7
Young growth	962	*	7,736	1	8,698	1
Plantations	7,004	1	10,656	1	17,660	1
TOTAL	46,390	9	98,096	10	144,486	10
Hardwood type:						
Mature	44,130	8	68,818	7	112,948	8
Immature	239,657	46	426,716	44	666,373	45
All-aged	76	*	20,490	2	20,566	1
Young growth	47,220	9	45,330	5	92,550	6
Plantations						
TOTAL	331,083	63	561,354	58	892,437	60
Mixedwoods type:						
Mature	7,656	1	18,650	2	26,306	2
Immature	134,769	26	230,852	24	365,621	25
All-aged	205	*	22,234	2	22,439	1
Young growth	4,216	1	28,140	3	32,356	2
Plantations						
TOTAL	146,846	28	299,876	31	446,722	30
Reproducing forest	2,270	*	3,756	1	6,026	*
TOTAL PRODUCTIVE FOREST	526,589	100	963,082	100	1,489,671	100

* Less than one per cent.

On Crown land the cover type distribution becomes 63 per cent hardwood, 28 per cent mixed-woods, and 9 per cent conifers. The same general distribution occurs on patented lands where hardwoods occur on 58 per cent of the area, mixedwoods on 31 per cent and conifers on 10 per cent. In this ownership classification, the area of reproducing forest is almost four thousand acres or one per cent of the productive area.

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

The volume of the primary growing stock on productive forest lands in the Lindsay district is just under two billion cubic feet (1,999,399,000 cubic feet). This is an average of 1,342 cubic feet per acre (table 5). The mature age class contains 394.4 million cubic feet (table 6), or 2,545 cubic feet per acre; the immature age class contains 1,537.9 million cubic feet, or 1,356 cubic feet per acre; and the all-aged stands contain 67.1 million cubic feet, or 1,560 cubic feet per acre.

Crown lands in the Lindsay district have a total volume slightly over 677 million cubic feet (table 7),

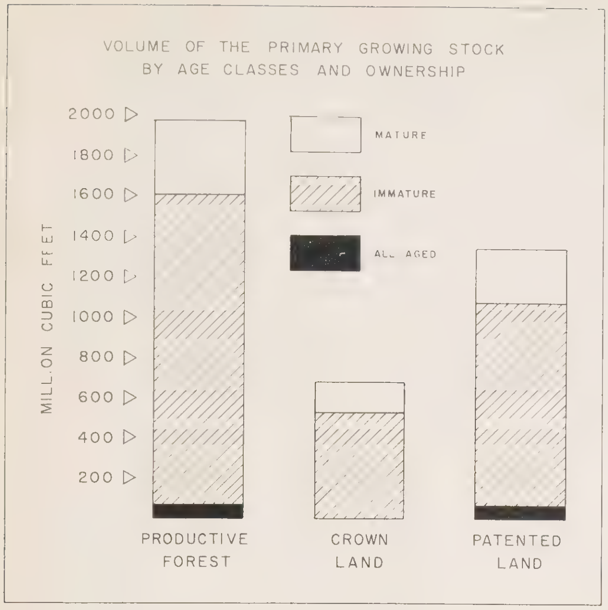


FIGURE 10

or an average of 1,286 cubic feet per acre. The mature age class contains 149.2 million cubic feet, or 2,629 cubic feet per acre; the immature age class contains 527.6 million cubic feet, or 1,294 cubic feet per acre. All-aged stands contain only 460 thousand cubic feet, or 1,634 cubic feet per acre.

Patented lands contain a primary growing stock of 1.3 billion cubic feet (table 8), averaging 1,373 cubic feet per acre. The mature age class totals 245.2 million cubic feet, or 2,496 cubic feet per acre;

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average Total
	4″-9″ d.b.h.	10″ up d.b.h.	Average total	4″-9″ d.b.h.	10″ up d.b.h.	Average total	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	577	2,052	2,629	558	1,938	2,496	2,545
Immature	666	628	1,294	761	630	1,391	1,356
All-aged	574	1,060	1,634	561	999	1,560	1,560
Productive forest	578	708	1,286	656	717	1,373	1,342

the immature age class contains 1,010.4 million cubic feet, or 1,391 cubic feet per acre; and all-aged stands contain 66.7 million cubic feet (fig. 10), or 1,560 cubic feet per acre.

Conifers vs. Hardwoods

Hardwoods, totalling 1,474 million cubic feet, comprise 74 per cent of the primary growing stock on the productive forest lands in the Lindsay district. The nine coniferous species contain 525 million cubic feet (table 9, fig. 11) or 26 per cent of the primary growing stock.

Crown lands, which support 677 million cubic feet, have 73 per cent of this volume in the hardwood group and 27 per cent in the conifers (table 10). Hardwoods form 85 per cent of the mature volume, 69 per cent of the immature volume and 75 per cent of the volume in all-aged stands.

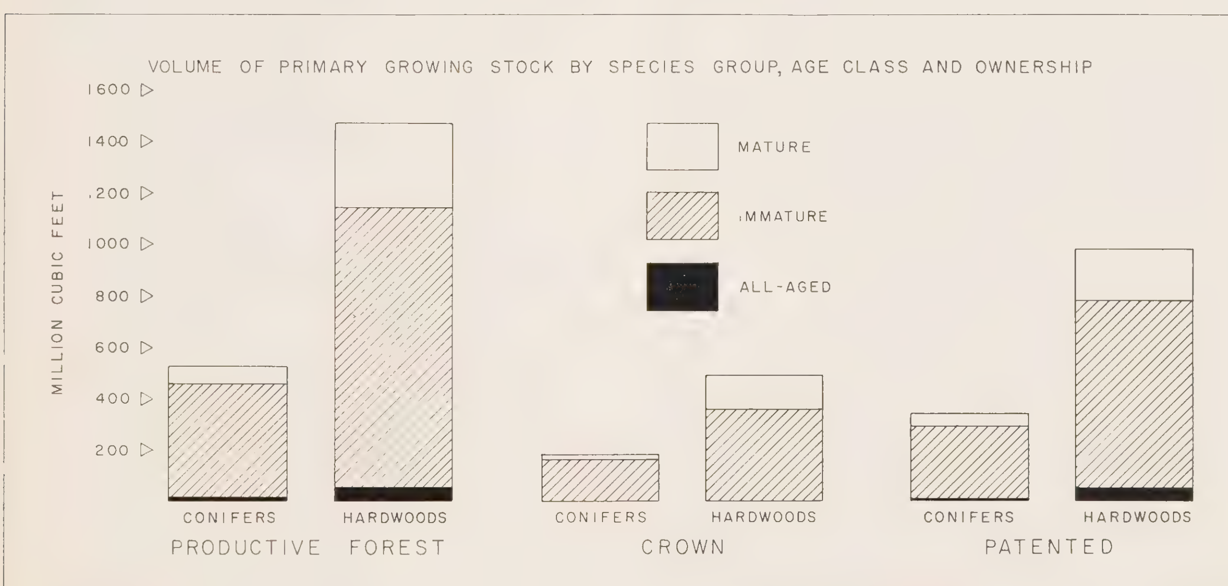


FIGURE 11

On patented lands, hardwoods form 74 per cent, and conifers 26 per cent, of the 1,322 million cubic feet of growing stock (table 11). The mature volume of 245 million cubic feet is composed of 82 per cent hardwoods and 18 per cent conifers. The immature volume of 1,010 million cubic feet is made up of 72 per cent hardwood volume and 28 per cent coniferous volume. All-aged stands contain nearly 67 million cubic feet. Hardwood species provide 80 per cent of this volume and conifers 20 per cent.

Three of the coniferous species comprise 72 per cent of the coniferous volume on productive forest lands. White cedar is the principal conifer, forming 31 per cent of the coniferous volume; white pine comprises 26 per cent and balsam fir 15 per cent. The hardwood group, which contains 16 species, has 72 per cent of the volume formed by five species. Sugar maple accounts for 31 per cent, poplar 19 per cent, elm 9 per cent, white birch 7 per cent and yellow birch 6 per cent.

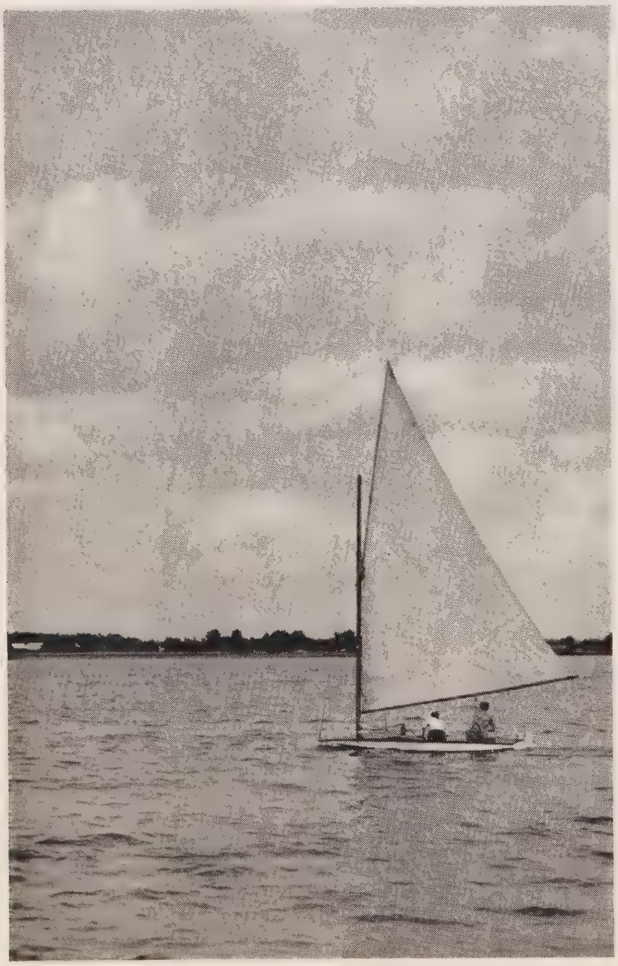


TABLE 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Lindsay district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	11,666	17,249	100,677	81,864	....	....	211,456
Hardwood	60,234	233,182	447,300	371,808	10,666	20,498	1,143,688
Mixedwoods	15,620	56,424	276,376	259,892	13,478	22,465	644,255
TOTAL	87,520	306,855	824,353	713,564	24,144	42,963	1,999,399

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	10,221	10,540	85,987	62,485	....	....	169,233
Hardwood	2,897	13,394	21,178	37,422	402	830	76,123
Mixedwoods	7,260	21,968	120,711	117,570	5,999	6,143	279,651
TOTAL	20,378	45,902	227,876	217,477	6,401	6,973	525,007

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,445	6,709	14,690	19,379	....	....	42,223
Hardwood	57,337	219,788	426,122	334,386	10,264	19,668	1,067,565
Mixedwoods	8,360	34,456	155,665	142,322	7,479	16,322	364,604
TOTAL	67,142	260,953	596,477	496,087	17,743	35,990	1,474,392

TABLE 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Lindsay district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total Crown land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	3,120	5,195	31,870	29,811	....	....	69,996
Hardwood	24,725	93,770	144,161	123,878	37	70	386,641
Mixedwoods	4,881	17,498	95,464	102,424	125	228	220,620
TOTAL	32,726	116,463	271,495	256,113	162	298	677,257

ALL CONIFERS

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total Crown land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	2,677	2,739	27,137	23,282	....	....	55,835
Hardwood	1,200	5,629	6,797	13,464	1	3	27,094
Mixedwoods	2,242	7,170	41,591	49,841	55	57	100,956
TOTAL	6,119	15,538	75,525	86,587	56	60	183,885

ALL HARDWOODS

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total Crown land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	443	2,456	4,733	6,529	....	....	14,161
Hardwood	23,525	88,141	137,364	110,414	36	67	359,547
Mixedwoods	2,639	10,328	53,873	52,583	70	171	119,664
TOTAL	26,607	100,925	195,970	169,526	106	238	493,372

TABLE 8. — *Cubic-foot volumes of primary growing stock on patented land in the Lindsay district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	8,546	12,054	68,807	52,053	....	....	141,460
Hardwood	35,509	139,412	303,139	247,930	10,629	20,428	757,047
Mixedwoods	10,739	38,926	180,912	157,468	13,353	22,237	423,635
TOTAL	54,794	190,392	552,858	457,451	23,982	42,665	1,322,142

ALL CONIFERS

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	7,544	7,801	58,850	39,203	....	....	113,398
Hardwood	1,697	7,765	14,381	23,958	401	827	49,029
Mixedwoods	5,018	14,798	79,120	67,729	5,944	6,086	178,695
TOTAL	14,259	30,364	152,351	130,890	6,345	6,913	341,122

ALL HARDWOODS

Cover type	Mature 4"-9" d.b.h.	Mature 10" up d.b.h.	Immature 4"-9" d.b.h.	Immature 10" up d.b.h.	All-aged 4"-9" d.b.h.	All-aged 10" up d.b.h.	Total patented land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,002	4,253	9,957	12,850	....	....	28,062
Hardwood	33,812	131,647	288,758	223,972	10,228	19,601	708,018
Mixedwoods	5,721	24,128	101,792	89,739	7,409	16,151	244,940
TOTAL	40,535	160,028	400,507	326,561	17,637	35,752	981,020

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4–9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material, depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller-size material in the top which may be used as pulpwood or for purposes other than saw timber. The total quantity of wood in this residual top is relatively small, and is included in the 10 inches and over material in all inventory estimates.

Within the Lindsay district, 53 per cent of the volume of the primary growing stock occurs within the larger size class. This size class also contains 270 million cubic feet, or 51 per cent, of the coniferous volume and 793 million cubic feet, or 54 per cent, of the hardwood volume (table 9).

If only the volume on Crown land is considered, the sawlog class contains 55 per cent of the total volume, 55 per cent of the hardwood volume and 56

Table 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Lindsay district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total all lands
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	869	6,311	24,572	99,854	731	2,683	135,020
Red pine	123	12	3,562	8,101	10	32	11,840
White spruce	2,609	2,069	18,731	26,674	109	195	50,387
Black spruce	988	1,627	3,143	1,521	5	5	7,289
Balsam fir	3,820	1,466	58,928	12,814	353	89	77,470
Hemlock	4,374	25,717	14,191	26,720	1,051	1,977	74,030
White cedar	7,146	8,476	99,888	39,887	4,045	1,915	161,357
Red cedar	324	195	550	103	49	32	1,253
Larch	125	29	4,311	1,803	48	45	6,361
Total Conifers	20,378	45,902	227,876	217,477	6,401	6,973	525,007
Sugar maple	31,367	132,306	145,056	138,060	5,188	8,317	460,294
Soft maple	2,505	4,168	36,948	16,804	2,274	4,025	66,724
White birch	1,856	2,865	67,180	24,094	818	746	97,559
Yellow birch	4,305	28,191	21,020	32,732	708	851	87,807
Beech	7,633	29,521	15,350	24,991	681	2,088	80,264
Elm	3,184	21,503	41,223	57,228	3,816	11,580	138,534
Ironwood	3,985	891	24,564	2,196	487	64	32,187
Red oak	725	4,123	38,813	37,072	294	1,304	82,331
White oak	88	349	931	537	362	884	3,151
Poplar	3,313	8,180	144,317	112,650	1,151	2,505	272,116
Black ash	3,134	1,629	26,533	6,729	808	273	39,106
White ash	1,669	5,659	11,413	12,391	408	988	32,528
Basswood	2,652	20,825	17,905	29,166	482	1,941	72,971
Black cherry	663	582	4,691	1,112	132	174	7,354
Butternut	10	67	93	147	23	93	433
Hickory	53	94	440	178	111	157	1,033
Total Hardwoods	67,142	260,953	596,477	496,087	17,743	35,990	1,474,392
TOTAL ALL SPECIES	87,520	306,855	824,353	713,564	24,144	42,963	1,999,399

Table 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Lindsay district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total Crown land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	291	1,610	9,782	42,413	5	19	54,120
Red pine	57	...	1,523	3,541	...	...	5,121
White spruce	1,138	769	7,493	11,352	...	2	20,754
Black spruce	428	722	1,220	610	...	...	2,980
Balsam fir	1,491	588	22,587	5,313	3	...	29,982
Hemlock	1,571	9,849	4,843	9,673	11	20	25,967
White cedar	1,117	1,998	26,968	13,109	36	18	43,246
Red cedar	2	1	5	...	...	...	8
Larch	24	1	1,104	576	1	1	1,707
Total Conifers	6,119	15,538	75,525	86,587	56	60	183,885
Sugar maple	12,818	53,229	46,592	49,007	23	47	161,716
Soft maple	831	737	12,151	5,297	13	24	19,053
White birch	695	1,075	22,202	8,465	7	8	32,452
Yellow birch	1,699	11,680	6,634	11,647	6	10	31,676
Beech	3,156	11,570	4,634	7,888	4	15	27,267
Elm	883	6,214	10,789	15,300	25	82	33,293
Ironwood	1,630	354	8,477	807	2	...	11,270
Red oak	297	1,495	14,551	13,627	2	6	29,978
White oak	1	4	6	4	2	4	21
Poplar	1,365	3,247	50,862	41,303	9	21	96,807
Black ash	1,219	629	8,710	2,422	6	2	12,988
White ash	666	2,154	3,476	4,208	3	4	10,511
Basswood	1,081	8,306	5,619	9,282	3	14	24,305
Black cherry	266	229	1,265	267	1	1	2,029
Butternut	...	1	...	1	...	...	2
Hickory	...	1	2	1	...	...	4
Total Hardwoods	26,607	100,925	195,970	169,526	106	238	493,372
TOTAL ALL SPECIES	32,726	116,463	271,495	256,113	162	298	677,257

per cent of the conifer volume. An analysis by age classes shows a different volume distribution. In the mature age class 78 per cent of the volume is in the 10-inch and over d.b.h. group. The immature age class, which contains 78 per cent of the volume on Crown lands, is more evenly distributed with 51 per cent in the smaller size class and 49 per cent in the larger. The relatively small volume in the all-aged stands is primarily in the sawlog size class (table 10).

The principal species in the mature age class on Crown lands produce mainly sawlog material (fig. 13). Of the leading conifers, only two — white spruce with 60 per cent and balsam fir with 72 per cent — have their volume concentrated in the 4 to 9-inch

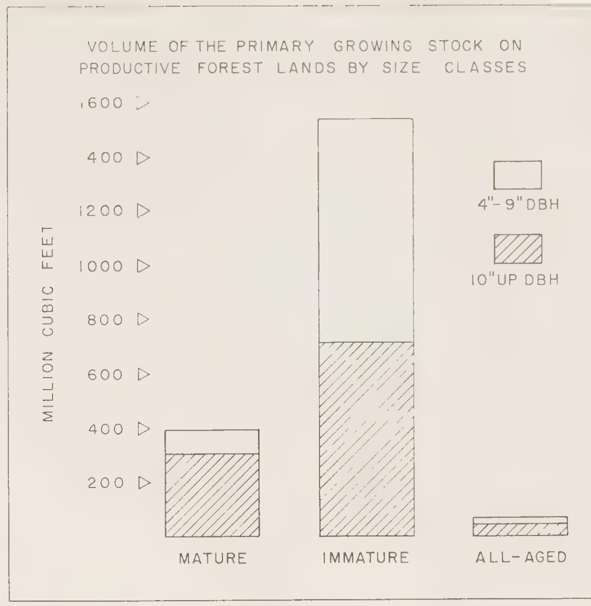


FIGURE 12

size class. The 10-inch and over size class contains 86 per cent of the hemlock, 85 per cent of the white pine and 64 per cent of the white cedar volume. The six main hardwood species are all primarily sawlog producers. Sugar maple has 81 per cent of its volume in this size class, yellow birch 87 per cent, beech 79 per cent, poplar 70 per cent, elm 88 per cent and basswood 88 per cent.

Of the five leading conifers in the immature age class, white pine, white spruce and hemlock produce primarily sawlog material, while balsam fir and white cedar produce mainly cordwood material (fig. 14). The 10-inch and over size class contains 51 per cent of the sugar maple volume, 64 per cent of the yellow birch and 59 per cent of the elm; the 4 to 9-inch size class contains 72 per cent of the white birch, 52 per cent of the red oak and 55 per cent of the poplar.

Patented lands contain 66 per cent of the primary growing stock within the district. Of this volume, 48 per cent is in the 4 to 9-inch d.b.h. class and 52 per cent in the 10-inch and over d.b.h. class. Conifers have 51 per cent of their volume in the smaller class, while hardwoods have 53 per cent of their volume in the larger (table 11). The sawlog class contains 78 per cent of the mature volume, 64 per cent of the all-aged volume, but only 45 per cent of the immature volume.

The five leading species by volume, on patented lands are sugar maple, poplar, white cedar, elm and

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Lindsay district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	4″-9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	578	4,701	14,790	57,441	726	2,664	80,900
Red pine	66	12	2,039	4,560	10	32	6,719
White spruce	1,471	1,300	11,238	15,322	109	193	29,633
Black spruce	560	905	1,923	911	5	5	4,309
Balsam fir	2,329	878	36,341	7,501	350	89	47,488
Hemlock	2,803	15,868	9,348	17,047	1,040	1,957	48,063
White cedar	6,029	6,478	72,920	26,778	4,009	1,897	118,111
Red cedar	322	194	545	103	49	32	1,245
Larch	101	28	3,207	1,227	47	44	4,654
TOTAL CONIFERS	14,259	30,364	152,351	130,890	6,345	6,913	341,122
Sugar maple	18,549	79,077	98,464	89,053	5,165	8,270	298,578
Soft maple	1,674	3,431	24,797	11,507	2,261	4,001	47,671
White birch	1,161	1,790	44,978	15,629	811	738	65,107
Yellow birch	2,606	16,511	14,386	21,085	702	841	56,131
Beech	4,477	17,951	10,716	17,103	677	2,073	52,997
Elm	2,301	15,289	30,434	41,928	3,791	11,498	105,241
Ironwood	2,355	537	16,087	1,389	485	64	20,917
Red oak	428	2,628	24,262	23,445	292	1,298	52,353
White oak	87	345	925	533	360	880	3,130
Poplar	1,948	4,933	93,455	71,347	1,142	2,484	175,309
Black ash	1,915	1,000	17,823	4,307	802	271	26,118
White ash	1,003	3,505	7,937	8,183	405	984	22,017
Basswood	1,571	12,519	12,286	19,884	479	1,927	48,666
Black cherry	397	353	3,426	845	131	173	5,325
Butternut	10	66	93	146	23	93	431
Hickory	53	93	438	177	111	157	1,029
TOTAL HARDWOODS	40,535	160,028	400,507	326,561	17,637	35,752	981,020
TOTAL ALL SPECIES	54,794	190,392	552,858	457,451	23,982	42,665	1,322,142

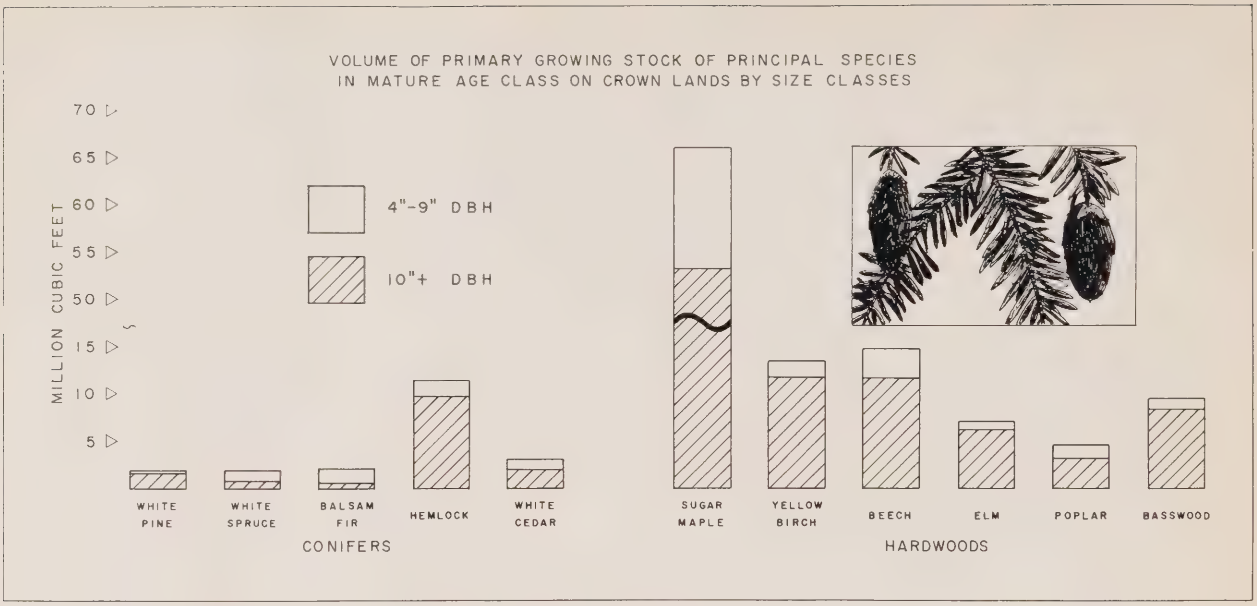


FIGURE 13

white pine. Sugar maple has 81 per cent of the mature, 62 per cent of the all-aged and 47 per cent of the immature volume in the sawlog size class. This class also contains 72 per cent of the mature poplar, 69 per cent of the all-aged and 43 per cent of the immature. White cedar is primarily a cordwood producer with 48 per cent of the mature, 73 per cent of the immature and 68 per cent of the all-aged volume in this size class. Elm produces mainly sawlogs in all age classes, having 87 per cent of the mature, 58 per cent of the immature and 75 per cent of the all-aged volume in the 10-inch and over class. White pine, with 89 per cent of the mature, 80 per cent of the immature and 79 per cent of the all-aged volume in the larger size class, is predominantly a sawlog producer (fig. 15).

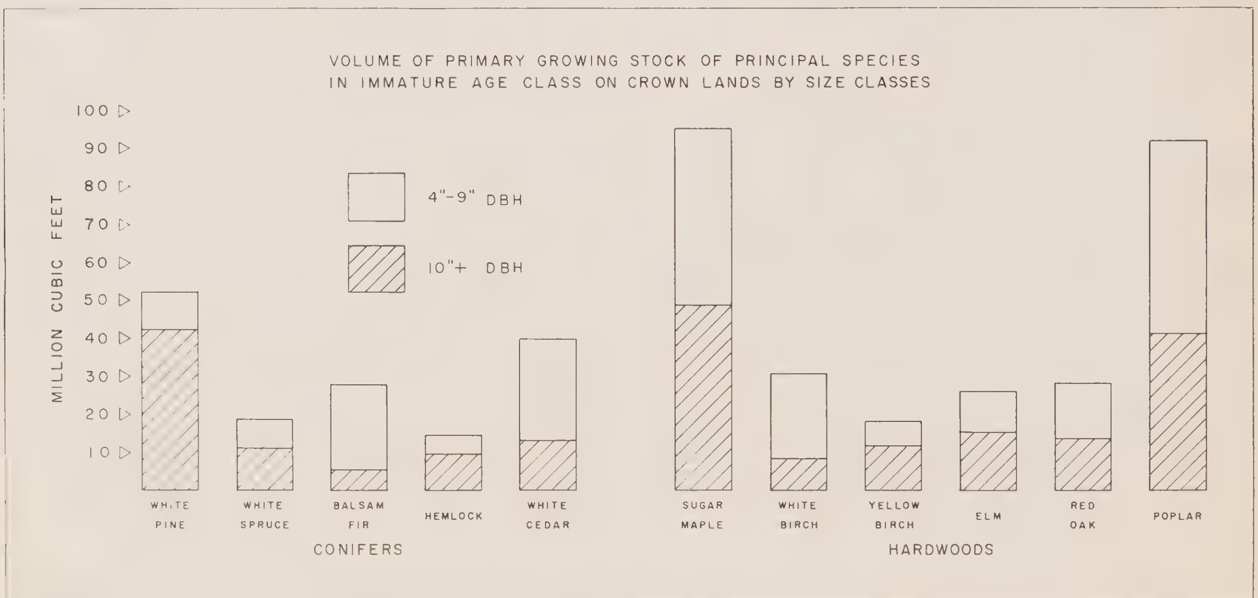


FIGURE 14

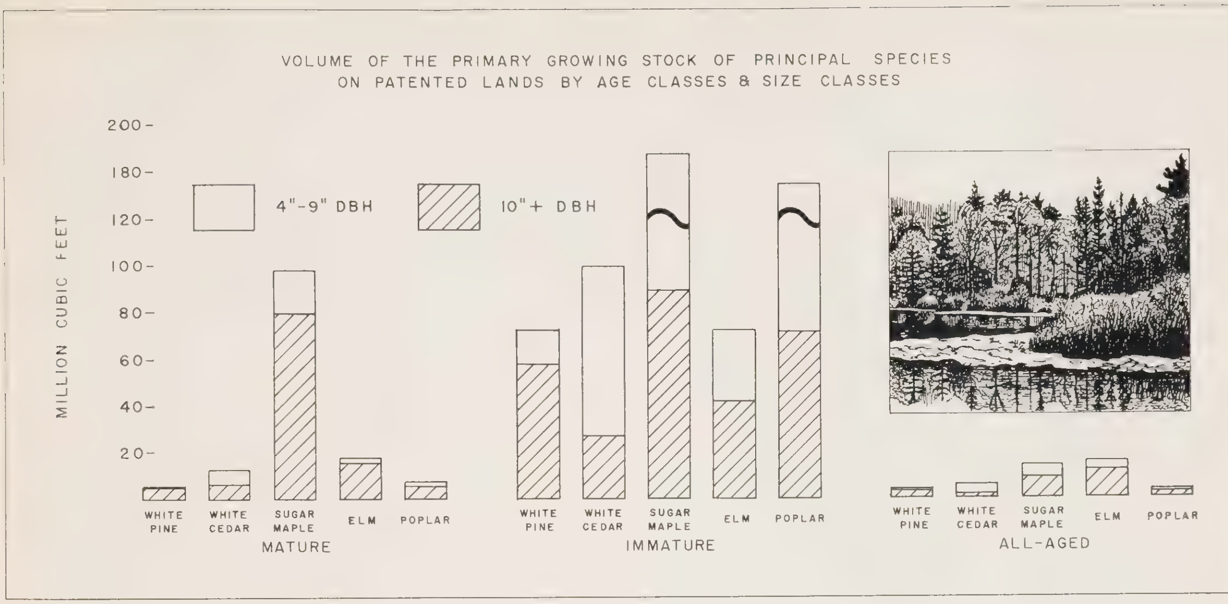


FIGURE 15

Allowable Cut

The allowable cut has been computed for each species with the aid of a volumetric formula[1] and appropriate rotation[2] for the species. Thus the amount of the allowable cut results from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

The calculation of allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. This is because of woods operations being carried out and the present stands growing in volume each year. Therefore, the size and structure of the primary growing stock, regarded as the foundation of the allowable cut calculations, also change from year to year; and for that reason, on expiration of the initial ten-year period, the allowable cut should be recalculated. With effective forestry practices, allowable cuts for the valuable species will increase; without them the proportion of less desirable species in the stands will grow greater.

The annual allowable cut, or net depletion permissible under management in the Lindsay district, is 38,602,715 cubic feet: 2,951,895 cubic feet from Crown lands and 35,650,820 cubic feet from patented lands. Of the total allowable cut, 92 per cent is on patented lands and 8 per cent on Crown lands.

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Lindsay district.*

Species	Annual allowable cut *cu. ft.*
White pine	47,510
Red pine	1,690
White spruce	57,190
Black spruce	28,735
Balsam fir	69,315
Hemlock	114,200
White cedar	46,730
Red cedar	40
Larch	750
TOTAL CONIFERS	366,160
Sugar maple	990,720
Soft maple	67,180
White birch	66,400
Yellow birch	267,590
Beech	220,900
Elm	141,965
Ironwood	59,530
Red oak	26,875
White oak	45
Poplar	276,730
Black ash	55,415
White ash	84,580
Basswood	312,900
Black cherry	14,860
Butternut	20
Hickory	25
TOTAL HARDWOODS	2,585,735
TOTAL ALL SPECIES	2,951,895

[1] Method of calculation of allowable cut is given in Appendix, methods, allowable cut, page 31.

[2] Rotation, by species, table 16, page 31.

CROWN LAND

The annual allowable cut for Crown lands represents 0.4 per cent of the primary growing stock, or 5.6 cubic feet per acre of the productive forest area. Of the total allowable cut 366,160 cubic feet, or 12 per cent, is composed of conifers and 2,585,735 cubic feet, or 88 per cent, of hardwoods (table 12).

Fifty per cent of the coniferous allowable cut is formed by two species, hemlock with 31 per cent and balsam fir with 19 per cent. Of the remainder, white spruce comprises 16 per cent, white pine 13 per cent, white cedar 13 per cent, while 8 per cent is made up by four miscellaneous conifers.

Six hardwood species contribute 85 per cent of the hardwood allowable cut. Sugar maple provides 38 per cent of the allowable cut, basswood 12 per cent, poplar 11 per cent, yellow birch 10 per cent, beech 9 per cent and elm 5 per cent. The remaining 15 per cent is composed of ten hardwood species.

PATENTED LAND

The annual allowable cut for patented lands is 35,650,820 cubic feet, which represents 2.7 per cent of the primary growing stock, or 37.0 cubic feet per acre of the productive forest land. Conifers comprise 21 per cent of the allowable cut and hardwoods 79 per cent (table 13).

Four species make up 85 per cent of the coniferous allowable cut: white cedar 30 per cent, white pine 23 per cent, balsam fir 20 per cent and white spruce 12 per cent.

The hardwood allowable cut is composed predominantly of two species: poplar, which comprises 39 per cent, and sugar maple, which forms 20 per cent. The next most important hardwoods are soft maple, which yields 8 per cent of the hardwood cut, white birch 7 per cent, elm 7 per cent and basswood 5 per cent (fig. 16). Ten hardwood species combine to produce the remaining 14 per cent.

TABLE 13. — *Annual allowable cut for all species on patented lands in the Lindsay district.*

Species	Annual allowable cut *cu. ft.*
White pine	1,685,425
Red pine	209,960
White spruce	926,040
Black spruce	89,760
Balsam fir	1,484,000
Hemlock	600,790
White cedar	2,214,575
Red cedar	23,345
Larch	116,355
TOTAL CONIFERS	7,350,250
Sugar maple	5,598,330
Soft maple	2,234,595
White birch	2,034,585
Yellow birch	877,045
Beech	662,460
Elm	1,973,275
Ironwood	392,190
Red oak	981,620
White oak	39,125
Poplar	10,956,795
Black ash	489,720
White ash	412,825
Basswood	1,520,795
Black cherry	99,845
Butternut	8,080
Hickory	19,285
TOTAL HARDWOODS	28,300,570
TOTAL ALL SPECIES	35,650,820

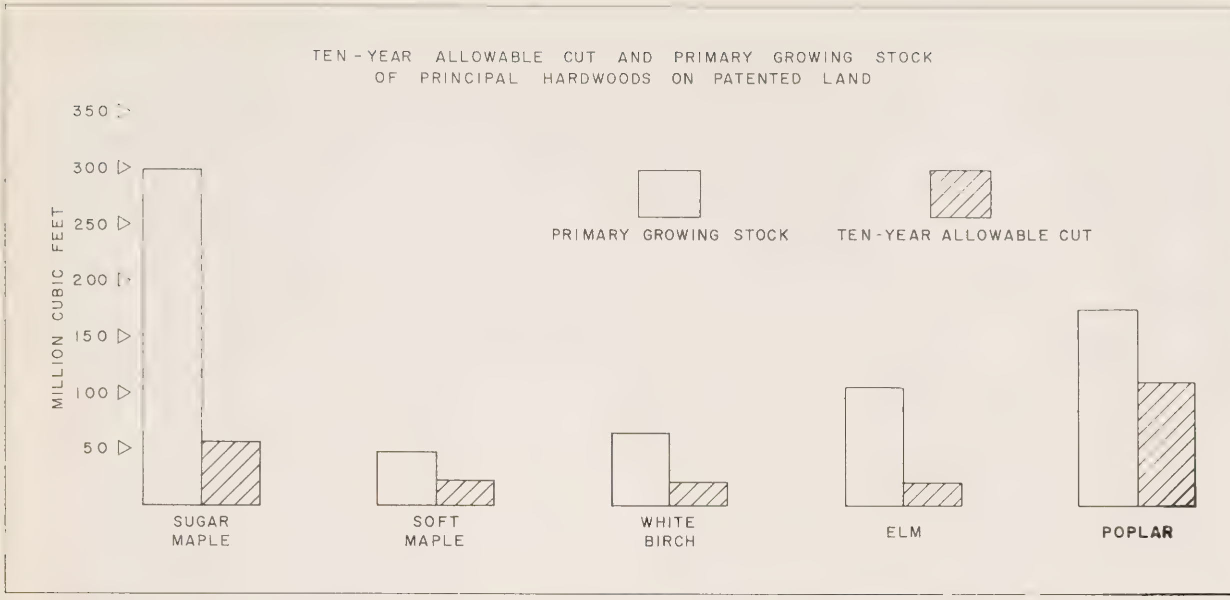
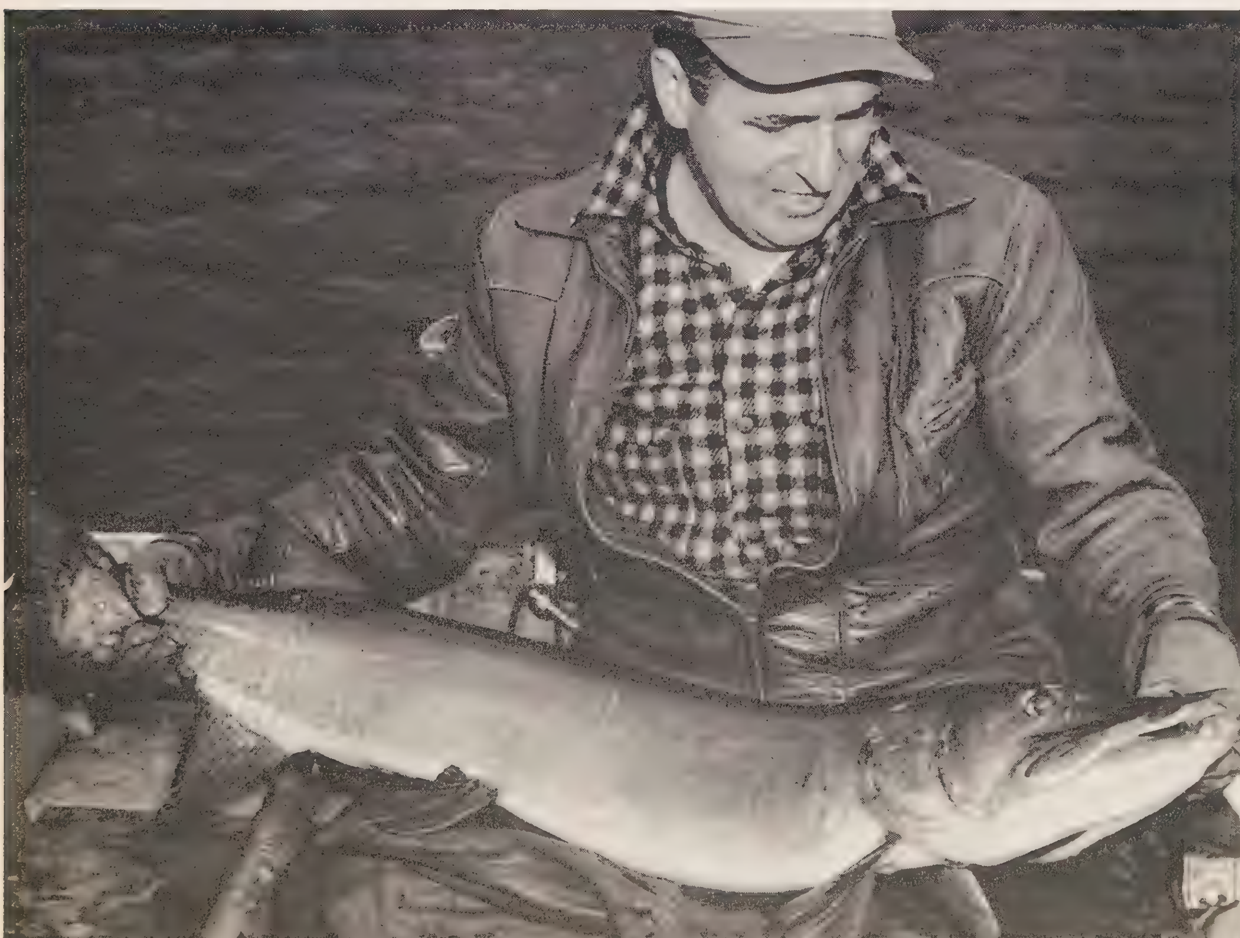

TEN-YEAR ALLOWABLE CUT AND PRIMARY GROWING STOCK
OF PRINCIPAL HARDWOODS ON PATENTED LAND
MILLION CUBIC FEET
350
300
250
200
150
100
50
PRIMARY GROWING STOCK
TEN-YEAR ALLOWABLE CUT
SUGAR MAPLE
SOFT MAPLE
WHITE BIRCH
ELM
POPLAR

Figure 16



Utilization vs. Allowable Cut

According to the Classification of Annual Timber Returns for the years ending March 31, 1947–1949[1] inclusive, the following average annual amounts of wood and wood products cut on Crown lands in the Lindsay district were as follows:

Logs and booms	5,008,398 F.B.M. Doyle rule
Dimension timber	5 pieces
Poles	121 pieces
Posts	4,594 pieces
Ties	182 pieces
Lagging	112 pieces
Fuelwood	569.13 cords
Pulpwood	507.80 cords

By the use of appropriate converting factors, these amounts are expressed in gross total cubic feet by species (table 14) and may be compared to the allowable cut figures (table 15).

A comparison of the annual allowable cut with the actual cut by species (table 15) indicates that, on the whole, conifers are being greatly overcut while the permissible cut for hardwoods is not being utilized. Red and white pine, hemlock and the two spruces are all being heavily overcut (fig. 17). The actual cut of hemlock is almost 9 times the allowable cut; the cut of red and white pine is 6 times the allowable cut; and the two spruces are being cut at a rate double the allowable cut. Only 40 per cent of the hardwood allowable cut is at present used, and no individual species is being overcut (fig. 18). In all probability yellow birch is being overcut and white birch undercut, and only the combination of these two species shows a surplus allowable cut.

Statistics concerning the utilization of timber from patented lands in the Lindsay district are not readily available and, therefore, no detailed comparison of actual and allowable cut can be made. Some idea of the size and value of wood products produced

TABLE 14. — *Gross total cubic-foot volumes of wood utilized annually from Crown land in the Lindsay district.*

Species	Wood utilized *cu. ft.*	Total *per cent*
Pine, white and red	317,146	12
Spruce, white and black	170,964	7
Balsam fir	11,997	*
Hemlock	1,016,578	39
White cedar	40,408	2
Larch	1,867	*
TOTAL CONIFERS	1,558,960	60
Sugar maple	615,414	24
Birch, yellow and white	168,017	6
Beech	38,483	1
Elm	14,363	1
Oak	16,196	1
Poplar	102,128	4
Ash	3,250	*
Basswood	82,652	3
TOTAL HARDWOODS	1,040,503	40
TOTAL ALL SPECIES	2,599,463	100

* Less than 0.50 per cent.

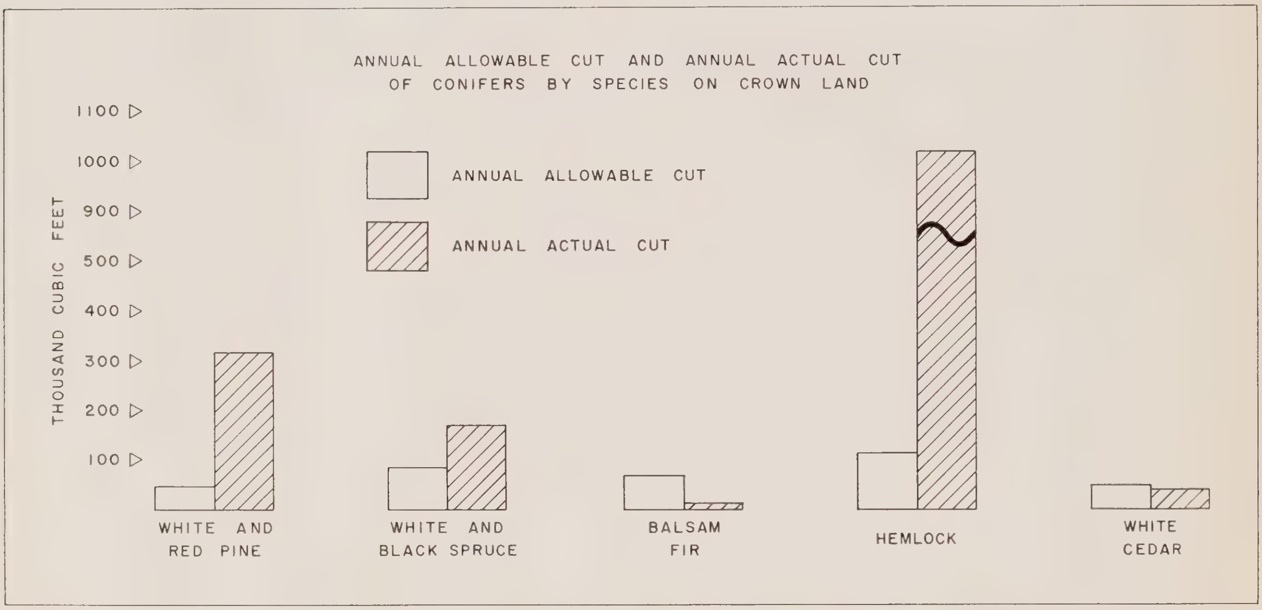


FIGURE 17

[1] Reports of the Minister of Lands and Forests, for the Province of Ontario, for the fiscal years ending March 31, 1948–1950.

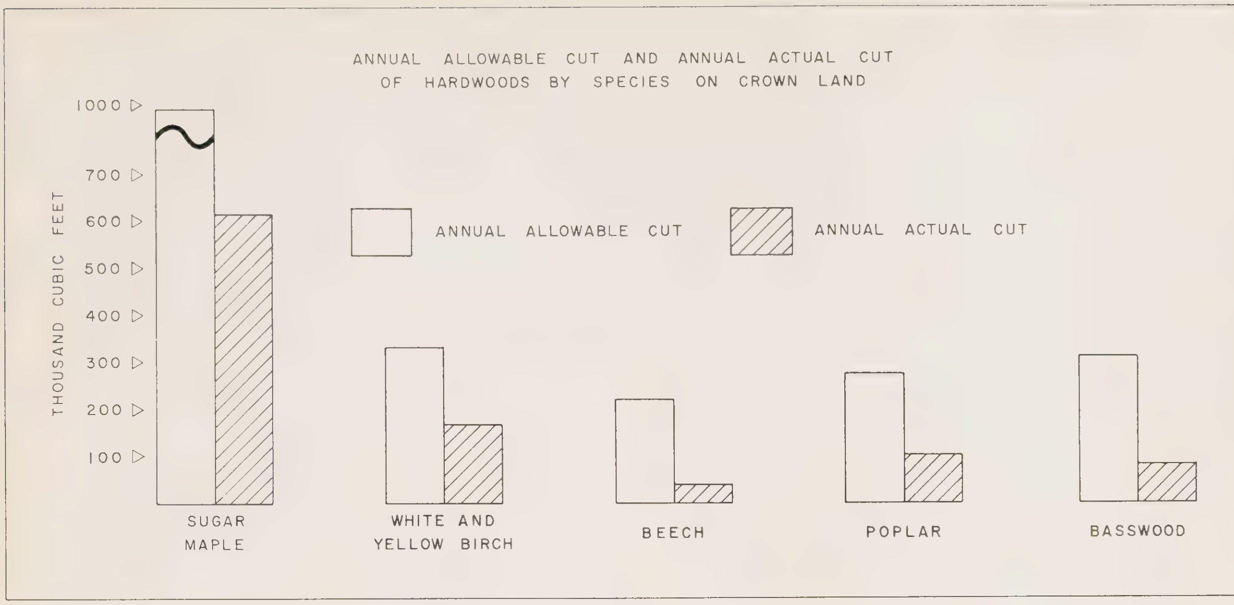


FIGURE 18

TABLE 15. — *Comparison of allowable cut with actual utilization by species on Crown land.*

Species	Allowable cut	Actual cut
	Thousand cu. ft.	*Thousand cu. ft.*
Pine, white and red	49	317
Spruce, white and black	86	171
Balsam fir	69	12
Hemlock	114	1,017
White cedar	47	40
Larch	1	2
TOTAL CONIFERS	366	1,559
Sugar maple	991	615
Birch, yellow and white	334	168
Beech	221	39
Elm	142	14
Oak	27	16
Poplar	277	102
Ash	140	3
Basswood	313	83
Other hardwoods	141	.
TOTAL HARDWOODS	2,586	1,040
TOTAL ALL SPECIES	2,952	2,599

by this source may be obtained from the volume of timber cut on farm woodlots[1]. During 1950, woodlots within the Lindsay district produced:

Fuelwood	49,354 cords
Pulpwood	880 cords
Pit props	4 cords
Logs	4,916,668 board feet
Posts	70,115 pieces
Poles	1,668 pieces

[1] Census of Canada, 1951, Volume VI, table 27.

Woodlots within the district are estimated to have produced in 1950[1] forest products, including maple syrup and maple sugar, valued at $792,383. The larger proportion of this material was utilized directly on the farm, but sufficient was sold to provide the farmers with a cash income of $312,335.

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs on a scale of four inches to the mile (1 /15,840). Following the photography, planimetric base maps were prepared by the Slotted Templet Method for the northern part of the district, and semi-controlled photo maps were prepared for the predominantly agricultural area in the south. Base maps cover the Algonquin section and mosaics the Huron section (fig. 7, page 16).

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario a photo map covers 7′30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map the prints are mounted on a hard surface non-porous board, such as masonite, upon which control points have been plotted. The road network of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted and makes the edges of the prints less perceptible to the eye and the camera. After a liberal application of adhesive, the print is oriented on to the control and adjusted to coincide with detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the photo map, it is photographed in two sections, producing an east and west half for each sheet. Upon production of the negative, prints are readily available.

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the appropriate planimetric map or mosaic. In each case the forest data were drafted on a linen overlay, and the ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1947, 1948, 1953 and 1954, and field sampling was carried out in the summers of 1951, 1955 and 1956. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. In the northern part of the district two age classes, mature and immature, were used; while in the south, an additional classification — all-aged — was added. The volume per acre of each cover type for the mature and immature age classes was then summarized from the field tallies into four density classes for the northern area, and three for the southern. The all-aged stands were not segregated into density classes. These summaries were made separately for the two ecological sections in the Lindsay district and for the different years during which field data were collected. The per acre volumes in cubic feet, made up in this manner, are shown in tables 17, 18 and 19.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by taking the total mature volume for each species and dividing by the rotation age for the species. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 17 cubic feet per acre, and for patented lands to 27 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

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[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department cf Lands and Forests, Ontario, Parts II and III.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years and the mature age class from 30 to 300 years, depending on the species. Stands classed as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 16).

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotations.

The compilation was carried out in such a way that volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory, for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

[1] Manual of Timber Management, Department of Lands and Forests, Ontario, Part II, page 50.

[2] L. Pardé — Traité pratique d'aménagement des forêts, Paris, 1930.

TABLE 16. — *Rotation by species.*

Species	Crown land	Patented land
	years	*years*
White pine	120	90
Red pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Red cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100
Butternut	100	100
Hickory	100	100

(b) FORMULA

In the present calculations, the following formulae were used:

$$\text{(1) Crown land:} \quad P = \frac{V.1.}{n/3}$$

$$\text{(2) Patented land:} \quad P = \frac{\frac{5}{8}\,(V.1. + V.2. + V.3.)}{n/3}$$

where:

V.1. — denotes volume of mature timber (Age Class I).
V.2. — denotes volume of immature timber (Age Class II).
V.3. — denotes volume of mature and immature timber in all-aged stands.
n — denotes rotation.
P — denotes annual allowable cut.

Formula (1) was used for Crown lands in accordance with the practice in Ontario to limit utilization on Crown lands to mature timber. At the present time, mature stands occupy only 11 per cent of the productive forest on Crown lands, and the resultant allowable cut is relatively small. Presently mature stands are expected to last for one-third of the rotation. On expiration of this period the presently immature stands, occupying 77 per cent of the productive Crown lands, will reach maturity and permit a considerable increase in the allowable cut.

Patented lands present a different problem, requiring a separate solution, thus the choice of formula (2). These lands also have a deficit of mature and an excess of immature age classes. Since the demand for wood is high in a relatively densely populated area, it may be assumed that this demand will be

met by utilizing presently immature stands on privately owned lands. In view of this, the allowable cut on patented lands is based on both mature and immature volumes, with the objective of obtaining a balanced yield over approximately two-thirds of the rotation. The method of calculation, coupled with the shorter rotation ages, gives a much larger allowable cut figure for patented lands than for Crown lands.

With the aid of these formulae, the allowable cut has been calculated separately for each species, with full consideration of the actual growing stock of each species and the appropriate rotation. The results of the individual calculations for each species have been totalled and shown as allowable cut for Crown lands and for patented lands, respectively.

Common and Botanical Names of Tree Species included in Timber Estimates

Conifers

White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Scots pine	*Pinus sylvestris L.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Red cedar	*Juniperus virginiana L.*
Eastern larch	*Larix laricina (Du Roi) K. Koch*
European larch	*Larix decidua Mill.*

Hardwoods

Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.* *Acer saccharinum L.*
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.* *Ulmus rubra Muhl.* *Ulmus Thomasi Sarg.*
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.*
White oak	*Quercus alba L.* *Quercus macrocarpa Michx.* *Quercus bicolor Willd.*
Poplar	*Populus tremuloides Michx.* *Populus balsamifera L.* *Populus grandidentata Michx.* *Populus deltoides Marsh.*
Carolina poplar	*Populus canadensis Moench var. eugenei Schelle*
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.* *Fraxinus pennsylvanica Marsh.* *Var. subintegerrima (Vahl) Fern.*
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch* *Carya cordiformis (Wang) K. Koch*
Black locust	*Robinia Pseudo-Acacia L.*

TABLE 17. — *Volume of the primary growing stock in cubic feet per acre.*
Algonquin Section — 1951

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	4	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	4
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	59.4	56.3	44.2	18.6	82.5	78.8	65.1	0.4
	10″ up	144.1	136.5	107.2	45.1	312.1	298.3	246.6	222.1
Red pine	4″–9″	18.0	17.1	13.4	5.6	16.8	16.1	13.3	14.6
	10″ up	....	....	....	....	24.7	23.6	19.5	93.1
Jack pine	4″–9″	277.4	262.9	206.4	86.8	....	....	....	49.1
	10″ up	72.9	69.1	54.2	22.8	....	....	....	....
White spruce	4″–9″	35.0	33.2	26.0	10.9	90.8	86.8	71.7	39.0
	10″ up	26.8	25.4	20.0	8.4	140.2	134.0	110.8	10.9
Black spruce	4″–9″	109.4	103.7	81.4	34.2	32.9	31.4	26.0	....
	10″ up	202.3	191.7	150.4	63.3	16.4	15.7	13.0	....
Balsam fir	4″–9″	102.1	96.7	75.9	31.9	215.3	205.8	170.1	78.8
	10″ up	62.8	59.5	46.7	19.7	49.5	47.3	39.1	....
Hemlock	4″–9″	116.7	110.6	86.8	36.5	32.5	31.1	25.6	2.6
	10″ up	249.1	236.0	185.3	78.0	55.8	53.3	44.1	....
White cedar	4″–9″	106.1	100.5	78.9	33.2	647.4	618.7	511.4	129.0
	10″ up	82.0	77.7	61.0	25.6	354.7	339.0	280.3	17.3
Larch	4″–9″	7.7	7.3	5.7	2.4	44.5	42.5	35.2	....
	10″ up	....	....	....	....	25.6	24.5	20.2	....
TOTAL CONIFERS	4″–9″	831.8	788.3	618.7	260.1	1162.7	1111.2	918.4	313.5
	10″ up	840.0	795.9	624.8	262.9	979.0	935.7	773.6	343.4
Sugar maple	4″–9″	6.5	6.2	4.8	2.0	8.3	7.9	6.5	1.8
	10″ up	253.7	240.3	188.7	79.4	15.1	14.4	12.0	....
Yellow birch	4″–9″	11.5	10.9	8.6	3.6	11.9	11.4	9.4	....
	10″ up	202.3	191.7	150.4	63.3	37.4	35.7	29.6	....
Elm	4″–9″	....	....	....	....	24.0	22.9	18.9	6.1
	10″ up	154.6	146.5	115.0	48.4	22.7	21.8	18.0	....
Ironwood	4″–9″	....	....	....	....	7.0	6.7	5.6	4.4
	10″ up	....	....	....	....	0.8	0.7	0.6	....
Oak	4″–9″								4.4
	10″ up								
White birch	4″–9″	2.7	2.6	2.0	0.9	43.3	41.4	34.2	....
	10″ up	25.6	24.3	19.1	8.0	29.4	28.1	23.2	....
Poplar (all)	4″–9″	61.2	58.0	45.5	19.2	65.2	62.4	51.5	28.3
	10″ up	101.1	95.8	75.2	31.6	119.1	113.8	94.1	174.1
Red maple	4″–9″	29.3	27.7	21.8	9.1	3.5	3.3	2.8	....
	10″ up	17.1	16.2	12.7	5.4	4.3	4.1	3.4	....
Ash	4″–9″	27.5	26.1	20.4	8.6	42.7	40.8	33.8	....
	10″ up	11.1	10.5	8.3	3.5	19.6	18.7	15.4	....
TOTAL HARDWOODS	4″–9″	138.7	131.5	103.1	43.4	205.9	196.8	162.7	45.0
	10″ up	765.5	725.3	569.4	239.6	248.4	237.3	196.3	174.1
GRAND TOTAL	4″–9″	970.5	919.8	721.8	303.5	1368.6	1308.0	1081.1	358.5
	10″ up	1605.5	1521.2	1194.2	502.5	1227.4	1173.0	969.9	517.5
TOTAL 4″ UP		2576.0	2441.0	1916.0	806.0	2596.0	2481.0	2051.0	876.0
		HARDWOODS MATURE (H-I)				HARDWOODS IMMATURE (H-II)			
White pine	4″–9″	....	....	....	....	7.9	7.5	5.9	4.9
	10″ up	....	....	....	....	44.4	42.0	33.0	38.5
White spruce	4″–9″	....	....	....	....	3.4	3.2	2.5	....
	10″ up	....	....	....	....	6.6	6.3	5.0	....
Balsam fir	4″–9″	10.5	10.2	8.9	6.8	23.3	22.0	17.4	7.3
	10″ up	4.8	4.7	4.1	....	4.8	4.6	3.6	2.8
Hemlock	4″–9″	15.2	14.8	12.9	8.1	10.2	9.7	7.6	....
	10″ up	128.4	125.2	108.9	22.9	28.0	26.5	20.9	....
White cedar	4″–9″	5.3	5.2	4.5	....	10.6	10.0	7.9	....
	10″ up	13.0	12.7	11.0	5.4	7.5	7.1	5.6	....
TOTAL CONIFERS	4″–9″	31.0	30.2	26.3	14.9	55.4	52.4	41.3	12.2
	10″ up	146.2	142.6	124.0	28.3	91.3	86.5	68.1	41.3

Table 17 — *(Cont'd)*

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) *(Cont'd)* Density Class 1	2	3	4	HARDWOODS IMMATURE (H-II) *(Cont'd)* Density Class 1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	314.7	306.8	266.9	72.8	332.8	315.1	248.0	53.4
	10″ up	1258.7	1227.4	1067.5	773.7	308.4	292.0	229.8	79.5
Yellow birch	4″–9″	36.0	35.1	30.6	1.6	40.7	38.5	30.3	5.8
	10″ up	232.8	227.1	197.4	142.8	53.8	50.9	40.1	10.6
Beech	4″–9″	76.7	74.8	65.1	16.5	41.3	39.2	30.8	
	10″ up	286.9	279.7	243.2	59.1	67.2	63.6	50.1	
Elm	4″–9″	18.8	18.4	16.0	9.6	43.5	41.2	32.5	21.0
	10″ up	121.7	118.6	103.2	78.1	71.1	67.3	52.9	26.9
Ironwood	4″–9″	40.4	39.4	34.3	18.9	55.7	52.8	41.5	8.8
	10″ up	8.5	8.3	7.2	....	4.6	4.3	3.4	0.7
Oak	4″–9″	7.6	7.4	6.5	6.0	71.8	67.9	53.5	47.1
	10″ up	38.2	37.3	32.4	33.2	79.0	74.8	58.9	29.1
White birch	4″–9″	11.8	11.5	10.0	1.4	97.2	92.1	72.5	24.9
	10″ up	15.7	15.3	13.3	....	31.4	29.7	23.4	8.5
Poplar (all)	4″–9″	22.8	22.2	19.3	....	179.4	169.8	133.7	124.1
	10″ up	44.4	43.3	37.7	....	120.1	113.7	89.5	51.0
Red maple	4″–9″	12.7	12.4	10.8	....	43.0	40.7	32.0	29.3
	10″ up	5.6	5.5	4.7	....	17.3	16.4	12.9	14.8
Ash	4″–9″	34.9	34.0	29.6	1.8	57.9	54.8	43.1	12.0
	10″ up	53.7	52.4	45.5	49.5	28.5	27.0	21.3	8.8
Basswood	4″–9″	26.8	26.1	22.7	....	42.6	40.4	31.8	6.1
	10″ up	196.2	191.4	166.4	41.8	63.9	60.5	47.6	14.1
Black cherry	4″–9″	6.6	6.3	5.6	....	10.1	9.6	7.5	....
	10″ up	5.6	5.5	4.8	....	2.0	1.8	1.5	....
Total Hardwoods	4″–9″	609.8	594.4	517.4	128.6	1016.0	962.1	757.2	332.5
	10″ up	2268.0	2211.8	1923.3	1178.2	847.3	802.0	631.4	244.0
GRAND TOTAL	4″–9″	640.8	624.6	543.7	143.5	1071.4	1014.5	798.5	344.7
	10″ up	2414.2	2354.4	2047.3	1206.5	938.6	888.5	699.5	285.3
TOTAL 4″ UP		3055.0	2979.0	2591.0	1350.0	2010.0	1903.0	1498.0	630.0
		MIXEDWOODS MATURE (M-I)				MIXEDWOODS IMMATURE (M-II)			
White pine	4″–9″	18.3	17.3	13.6	....	86.6	80.2	61.3	30.1
	10″ up	202.0	191.2	150.1	....	303.6	281.1	214.9	148.1
Red pine	4″–9″	....	....	....	....	15.0	13.9	10.6	3.4
	10″ up	....	....	....	....	34.8	32.2	24.6	6.2
White spruce	4″–9″	28.8	27.2	21.4	....	56.8	52.6	40.2	24.0
	10″ up	81.4	77.1	60.5	....	76.8	71.1	54.4	59.1
Black spruce	4″–9″	15.3	14.5	11.4	....	8.8	8.1	6.2	
	10″ up	16.2	15.3	12.0	....	4.3	4.0	3.1	
Balsam fir	4″–9″	136.4	129.2	101.4	2.5	211.8	196.2	150.0	33.9
	10″ up	36.7	34.7	27.3	....	42.2	39.0	29.8	18.8
Hemlock	4″–9″	106.4	100.7	79.1	54.7	40.7	37.7	28.8	13.2
	10″ up	731.5	692.5	543.7	....	61.4	56.9	43.5	39.5
White cedar	4″–9″	89.1	84.3	66.2	46.5	171.4	158.7	121.3	12.9
	10″ up	205.9	195.0	153.1	14.5	74.8	69.3	53.0	3.1
Larch	4″–9″	....	....	....	....	2.2	2.0	1.6	
	10″ up	....	....	....	....	0.4	0.4	0.3	
Total Conifers	4″–9″	394.3	373.2	293.1	103.7	593.3	549.4	420.0	117.5
	10″ up	1273.7	1205.8	946.7	14.5	598.3	554.0	423.6	274.8
Sugar maple	4″–9″	115.7	109.5	86.0	18.3	95.4	88.3	67.6	34.8
	10″ up	612.1	579.4	454.9	450.7	77.5	71.7	54.8	96.2
Yellow birch	4″–9″	49.2	46.5	36.5	....	27.3	25.3	19.3	2.2
	10″ up	363.9	344.5	270.5	27.4	64.4	59.6	45.6	11.4
Beech	4″–9″	35.6	33.7	26.5	8.7	8.1	7.5	5.7	1.5
	10″ up	74.6	70.6	55.4	....	12.9	11.9	9.1	9.7
Elm	4″–9″	23.7	22.4	17.6	....	47.6	44.1	33.7	11.4
	10″ up	145.5	137.7	108.1	164.2	67.6	62.6	47.9	10.2

TABLE 17 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*)				MIXEDWOODS IMMATURE (M-II) (*Cont'd*)			
		DENSITY CLASS				DENSITY CLASS			
		1	2	3	4	1	2	3	4
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Ironwood	4″–9″ 10″ up	11.5 4.2	10.9 4.0	8.6 3.1	15.4 18.2	17.1 1.2	15.9 1.1	12.2 0.8	16.2 3.8
Oak	4″–9″ 10″ up	....	....	....	.... 22.4	24.0 23.1	22.2 21.4	17.0 16.4	16.8 25.5
White birch	4″–9″ 10″ up	41.3 68.9	39.1 65.2	30.7 51.2	.... 19.9	133.9 59.9	124.0 55.4	94.8 42.4	17.5 4.8
Poplar (all)	4″–9″ 10″ up	53.7 217.7	50.9 206.1	40.0 161.8	....	258.2 278.7	239.1 258.0	182.8 197.3	45.0 67.7
Red maple	4″–9″ 10″ up	43.1 74.9	40.8 70.9	32.0 55.7	....	58.4 25.4	54.1 23.5	41.3 18.0	19.6 5.2
Ash	4″–9″ 10″ up	80.4 108.4	76.2 102.6	59.8 80.6	29.4 219.4	66.8 38.0	61.8 35.2	47.2 26.9	4.3 2.9
Basswood	4″–9″ 10″ up	9.4 128.3	8.9 121.4	7.0 95.3	4.1 109.1	12.6 24.1	11.7 22.3	8.9 17.0	....
Black cherry	4″–9″ 10″ up	2.6 1.3	2.4 1.3	1.9 1.0	.... 18.6	4.2 1.0	3.9 1.0	3.0 0.7	....
TOTAL HARDWOODS	4″–9″ 10″ up	466.2 1799.8	441.3 1703.7	346.6 1337.6	75.9 1049.9	753.6 673.8	697.9 623.7	533.5 476.9	169.3 237.4
GRAND TOTAL	4″–9″ 10″ up	860.5 3073.5	814.5 2909.5	639.7 2284.3	179.6 1064.4	1346.9 1272.1	1247.3 1177.7	953.5 900.5	286.8 512.2
TOTAL 4″ UP		3934.0	3724.0	2924.0	1244.0	2619.0	2425.0	1854.0	799.0

Table 18. — *Volume of the primary growing stock in cubic feet per acre. Huron Section — 1954–1955*

Species	D.B.H.	Coniferous Mature (C-I)			Coniferous Immature (C-II)			All-Aged
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	26.3	24.1	16.9	26.4	23.1	15.2	....
	10″ up	294.9	269.2	189.1	72.9	63.9	41.8	
White spruce	4″–9″	10.6	9.7	6.8	36.1	31.6	20.7	
	10″ up	36.4	33.2	23.4	36.0	31.5	20.6	
Black spruce	4″–9″	4.5	4.1	2.9	10.8	9.6	6.2	
	10″ up	3.3	3.1	2.1	2.8	2.4	1.6	
Balsam fir	4″–9″	31.0	28.3	19.9	51.5	45.1	29.5	
	10″ up	8.2	7.5	5.2	6.9	6.1	4.0	....
Hemlock	4″–9″	54.0	49.4	34.7	16.0	14.0	9.2	....
	10″ up	141.8	129.5	90.9	19.1	16.7	10.9	
White cedar	4″–9″	855.6	781.6	548.9	1004.4	879.6	575.9	....
	10″ up	575.2	525.4	369.0	180.0	157.7	103.2	....
Red cedar	4″–9″	72.3	66.0	46.4	49.1	43.0	28.1	....
	10″ up	42.6	38.9	27.3	9.3	8.2	5.4	....
Larch	4″–9″	14.3	13.1	9.1	51.5	45.1	29.5	....
	10″ up	4.0	3.6	2.6	5.0	4.4	2.9	....
Total Conifers	4″–9″	1068.6	976.3	685.6	1245.8	1091.1	714.3	....
	10″ up	1106.4	1010.4	709.6	332.0	290.9	190.4	....
Sugar maple	4″–9″	5.2	4.8	3.4	4.2	3.7	2.4	
	10″ up	60.1	54.8	38.5	5.5	4.8	3.2	....
Soft maple	4″–9″	4.7	4.2	3.0	3.0	2.7	1.8	....
	10″ up	5.8	5.3	3.7	4.8	4.1	2.7	....
White birch	4″–9″	17.2	15.7	11.1	25.1	21.9	14.4	....
	10″ up	19.4	17.7	12.4	10.0	8.8	5.7	....
Yellow birch	4″–9″	15.1	13.8	9.7	10.6	9.3	6.1	
	10″ up	18.8	17.2	12.1	6.9	6.1	4.0	
Beech	4″–9″	1.7	1.6	1.1	0.5	0.4	0.3	....
	10″ up	16.6	15.1	10.6	1.5	1.3	0.8	....
Elm	4″–9″	29.9	27.3	19.2	69.9	61.2	40.0	
	10″ up	108.5	99.1	69.6	95.7	83.8	54.9	
Ironwood	4″–9″	5.6	5.2	3.6	2.0	1.7	1.1	
	10″ up	2.2	2.0	1.4	....	....	....	
Red oak	4″–9″	0.7	0.7	0.5	....	....		
	10″ up	12.4	11.2	7.9	....			
White oak	4″–9″	10.2	9.3	6.5	5.6	4.9	3.2	
	10″ up	23.7	21.7	15.3	4.1	3.6	2.4	
Poplar (all)	4″–9″	11.4	10.4	7.3	40.2	35.2	23.1	
	10″ up	19.9	18.2	12.8	45.5	39.9	26.1	
Black ash	4″–9″	7.2	6.7	4.6	10.6	9.3	6.1	
	10″ up	0.6	0.5	0.4	1.1	0.9	0.6	
White ash	4″–9″	1.3	1.2	0.8	2.1	1.8	1.2	...
	10″ up	6.5	6.0	4.2	1.8	1.6	1.0	
Basswood	4″–9″	1.7	1.6	1.1	2.0	1.7	1.1	
	10″ up	19.2	17.5	12.3	7.7	6.8	4.5	
Black cherry	4″–9″	....	....	....	0.7	0.6	0.4	
	10″ up	....	....	....	1.3	1.1	0.7	
Butternut	4″–9″	....	....	....	0.5	0.4	0.3	
	10″ up	....	....	....	1.5	1.3	0.8	
Hickory	4″–9″	3.7	3.4	2.4	3.7	3.3	2.2	
	10″ up	6.7	6.1	4.3	2.1	1.8	1.2	
Total Hardwoods	4″–9″	115.6	105.9	74.3	180.7	158.1	103.7	
	10″ up	320.4	292.4	205.5	189.5	165.9	108.6	
Grand Total	4″–9″	1184.2	1082.2	759.9	1426.5	1249.2	818.0	....
	10″ up	1426.8	1302.8	915.1	521.5	456.8	299.0	
Total 4″ up		2611.0	2385.0	1675.0	1948.0	1706.0	1117.0	

Table 18 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) Density Class			HARDWOODS IMMATURE (H-II) Density Class			HARDWOODS ALL-AGED
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	3.1	3.0	2.4	11.8	10.6	7.6	4.7
	10″ up	37.9	36.7	29.9	17.4	15.7	11.1	21.5
White spruce	4″–9″	....	....	....	0.7	0.6	0.5	0.4
	10″ up	....	....	....	0.7	0.6	0.4	0.7
Balsam fir	4″–9″	....	....	....	1.3	1.1	0.9	0.8
	10″ up	....	....	....	0.1	0.1	....	0.1
Hemlock	4″–9″	3.8	3.6	3.0	3.2	2.9	2.0	2.5
	10″ up	9.9	9.6	7.8	5.1	4.6	3.3	8.3
White cedar	4″–9″	8.1	7.9	6.4	21.4	19.3	13.7	8.5
	10″ up	2.8	2.7	2.2	6.4	5.7	4.1	2.7
Total Conifers	4″–9″	15.0	14.5	11.8	38.4	34.5	24.7	16.9
	10″ up	50.6	49.0	39.9	29.7	26.7	18.9	33.3
Sugar maple	4″–9″	155.7	150.6	122.7	190.9	171.7	122.3	140.0
	10″ up	823.8	796.3	648.8	73.2	65.8	46.8	228.5
Soft maple	4″–9″	81.8	79.1	64.5	151.2	136.0	96.8	81.0
	10″ up	402.5	389.1	316.9	54.5	49.0	34.9	138.6
White birch	4″–9″	3.0	2.9	2.4	32.1	28.9	20.5	4.7
	10″ up	5.2	5.0	4.1	4.0	3.6	2.6	3.9
Yellow birch	4″–9″	7.4	7.1	5.8	6.0	5.5	3.9	4.0
	10″ up	6.3	6.1	5.0	2.3	2.0	1.4	2.3
Beech	4″–9″	30.6	29.6	24.1	21.2	19.0	13.5	20.8
	10″ up	158.2	152.9	124.6	14.9	13.5	9.6	41.1
Elm	4″–9″	105.0	101.5	82.7	179.7	161.6	115.1	98.7
	10″ up	516.1	498.9	406.5	131.7	118.4	84.3	223.3
Ironwood	4″–9″	21.3	20.6	16.8	23.9	21.5	15.3	11.6
	10″ up	3.3	3.2	2.6	1.1	1.0	0.7	1.6
Red oak	4″–9″	3.0	2.9	2.4	49.0	44.1	31.4	7.3
	10″ up	65.4	63.2	51.5	30.2	27.1	19.3	35.0
White oak	4″–9″	3.7	3.6	2.9	25.4	22.8	16.2	8.8
	10″ up	23.7	22.9	18.6	12.1	11.0	7.8	23.3
Poplar (all)	4″–9″	2.7	2.6	2.1	119.8	107.7	76.7	12.0
	10″ up	16.4	15.9	13.0	31.7	28.5	20.3	15.8
Black ash	4″–9″	11.0	10.6	8.7	20.0	18.0	12.8	9.8
	10″ up	2.7	2.6	2.1	0.9	0.8	0.6	1.2
White ash	4″–9″	9.4	9.1	7.4	31.6	28.4	20.3	10.8
	10″ up	39.8	38.5	31.4	14.3	12.8	9.1	22.8
Basswood	4″–9″	10.7	10.4	8.4	28.9	26.0	18.5	10.5
	10″ up	123.4	119.2	97.2	32.3	29.0	20.7	43.0
Black cherry	4″–9″	2.7	2.6	2.1	10.6	9.6	6.8	2.5
	10″ up	2.8	2.7	2.2	1.9	1.7	1.2	2.4
Butternut	4″–9″	0.2	0.2	0.2	3.1	2.8	2.0	0.9
	10″ up	10.7	10.4	8.4	3.9	3.5	2.5	4.3
Hickory	4″–9″	6.7	6.5	5.3	15.0	13.5	9.6	6.7
	10″ up	15.2	14.7	11.9	4.5	4.0	2.9	8.6
Total Hardwoods	4″–9″	454.9	439.9	358.5	908.4	817.1	581.7	430.1
	10″ up	2215.5	2141.6	1744.8	413.5	371.7	264.7	795.7
GRAND TOTAL	4″–9″	469.9	454.4	370.3	946.8	851.6	606.4	447.0
	10″ up	2266.1	2190.6	1784.7	443.2	398.4	283.6	829.0
TOTAL 4″ UP		2736.0	2645.0	2155.0	1390.0	1250.0	890.0	1276.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	14.9	14.0	10.4	54.5	46.6	37.5	32.7
	10″ up	192.2	180.5	134.5	62.3	53.2	42.7	110.8
Red pine	4″–9″	....	....	....	2.9	2.5	2.0	0.6
	10″ up	2.7	2.6	1.9	2.0	1.7	1.4	1.9
White spruce	4″–9″	3.4	3.2	2.4	22.4	19.1	15.4	4.7
	10″ up	10.2	9.6	7.1	17.1	14.6	11.7	9.1

Table 18 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Black spruce	4″–9″	....	....	....	3.0	2.5	2.1	0.3
	10″ up	....	....	....	0.3	0.3	0.2	0.3
Balsam fir	4″–9″	11.2	10.5	7.9	35.8	30.6	24.6	13.6
	10″ up	7.9	7.4	5.5	2.0	1.7	1.4	3.5
Hemlock	4″–9″	58.2	54.6	40.7	9.1	7.8	6.3	33.3
	10″ up	192.5	180.8	134.8	10.6	9.1	7.3	61.4
White cedar	4″–9″	188.7	177.2	132.1	297.1	253.8	204.1	178.8
	10″ up	236.4	222.0	165.4	54.9	46.9	37.7	76.2
Red cedar	4″–9″	6.3	5.9	4.4	4.2	3.6	2.9	2.9
	10″ up	4.6	4.3	3.2	0.7	0.6	0.5	1.9
Larch	4″–9″	3.2	3.0	2.3	14.0	12.0	9.6	1.8
	10″ up	2.2	2.1	1.5	2.5	2.1	1.7	1.6
TOTAL CONIFERS	4″–9″	285.9	268.4	200.2	443.0	378.5	304.5	268.7
	10″ up	648.7	609.3	453.9	152.4	130.2	104.6	266.7
Sugar maple	4″–9″	45.2	42.5	31.6	32.9	28.1	22.6	38.2
	10″ up	240.9	226.2	168.6	16.5	14.1	11.3	64.0
Soft maple	4″–9″	24.4	22.9	17.1	21.1	18.1	14.5	36.8
	10″ up	92.8	87.1	64.9	13.4	11.4	9.2	63.8
White birch	4″–9″	14.6	13.7	10.2	66.6	56.8	45.7	26.6
	10″ up	29.0	27.3	20.3	12.4	10.6	8.5	19.3
Yellow birch	4″–9″	35.6	33.4	24.9	18.9	16.1	13.0	22.0
	10″ up	84.3	79.2	59.0	7.4	6.4	5.1	23.1
Beech	4″–9″	11.5	10.8	8.1	3.3	2.8	2.3	6.1
	10″ up	83.9	78.8	58.7	1.6	1.4	1.1	15.6
Elm	4″–9″	95.7	89.9	67.0	213.5	182.3	146.6	95.2
	10″ up	670.0	629.2	468.9	197.8	168.9	135.9	278.9
Ironwood	4″–9″	8.9	8.4	6.2	7.8	6.6	5.3	9.9
	10″ up	2.0	1.8	1.4	0.4	0.4	0.3	0.7
Red oak	4″–9″	4.3	4.1	3.0	23.5	20.1	16.1	7.1
	10″ up	66.6	62.4	46.6	14.3	12.2	9.9	26.3
White oak	4″–9″	7.4	6.9	5.1	14.4	12.3	9.9	14.5
	10″ up	33.5	31.5	23.5	10.3	8.8	7.0	33.4
Poplar (all)	4″–9″	3.1	2.9	2.2	171.4	146.4	117.7	31.2
	10″ up	26.9	25.3	18.8	123.1	105.1	84.6	74.4
Black ash	4″–9″	25.0	23.5	17.5	29.9	25.5	20.5	20.6
	10″ up	7.7	7.2	5.4	1.4	1.2	1.0	2.6
White ash	4″–9″	6.3	5.9	4.4	7.1	6.0	4.9	4.7
	10″ up	26.4	24.8	18.5	4.4	3.8	3.0	10.4
Basswood	4″–9″	12.4	11.7	8.7	8.1	6.9	5.6	8.9
	10″ up	112.9	106.0	79.0	14.9	12.8	10.2	34.4
Black cherry	4″–9″	4.0	3.7	2.8	2.9	2.5	2.0	1.8
	10″ up	1.5	1.4	1.0	0.4	0.3	0.3	1.6
Butternut	4″–9″	2.1	1.9	1.4	1.0	0.8	0.7	0.7
	10″ up	6.1	5.8	4.3	2.3	2.0	1.6	2.3
Hickory	4″–9″	3.0	2.8	2.1	3.7	3.1	2.5	1.6
	10″ up	2.4	2.3	1.7	2.9	2.5	2.0	2.9
TOTAL HARDWOODS	4″–9″	303.5	285.0	212.3	626.1	534.4	429.9	325.9
	10″ up	1486.9	1396.3	1040.6	423.5	361.9	291.0	653.7
GRAND TOTAL	4″–9″	589.4	553.4	412.5	1069.1	912.9	734.4	594.6
	10″ up	2135.6	2005.6	1494.5	575.9	492.1	395.6	920.4
TOTAL 4″ UP		2725.0	2559.0	1907.0	1645.0	1405.0	1130.0	1515.0

Table 19. — *Volume of the primary growing stock in cubic feet per acre. Huron Section — 1956*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	18.7	15.9	9.9	20.9	16.5	9.2	....
	10″ up	120.7	102.8	64.3	75.0	59.2	33.2	....
White spruce	4″–9″	3.0	2.5	1.6	35.0	27.6	15.5	....
	10″ up	13.2	11.3	7.0	20.1	15.9	8.9	....
Balsam fir	4″–9″	35.0	29.8	18.6	126.8	100.1	56.0	....
	10″ up	20.1	17.1	10.7	21.8	17.3	9.7	....
Hemlock	4″–9″	127.8	108.8	68.0	72.5	57.2	32.0	....
	10″ up	361.7	307.9	192.5	100.1	79.1	44.3	....
White cedar	4″–9″	682.1	580.7	362.9	1055.6	833.6	466.8	....
	10″ up	861.1	733.0	458.2	250.8	198.1	110.9	....
Larch	4″–9″	0.7	0.6	0.4	44.8	35.4	19.9	....
	10″ up	5.8	4.9	3.1	10.3	8.1	4.5	....
Total Conifers	4″–9″	867.3	738.3	461.4	1355.6	1070.4	599.4	....
	10″ up	1382.6	1177.0	735.8	478.1	377.7	211.5	....
Sugar maple	4″–9″	10.2	8.7	5.4	6.6	5.2	2.9	....
	10″ up	151.9	129.3	80.9	34.1	27.0	15.1	....
Soft maple	4″–9″	8.7	7.4	4.6	17.2	13.6	7.6	....
	10″ up	46.4	39.5	24.7	16.4	12.9	7.2	....
White birch	4″–9″	16.5	14.0	8.8	51.7	40.8	22.9	....
	10″ up	19.2	16.4	10.2	20.2	16.0	8.9	....
Yellow birch	4″–9″	35.3	30.1	18.8	30.7	24.2	13.6	....
	10″ up	120.3	102.4	64.0	29.2	23.1	12.9	....
Beech	4″–9″	4.9	4.2	2.6	0.9	0.7	0.4	....
	10″ up	131.3	111.7	69.9	11.1	8.8	4.9	....
Elm	4″–9″	15.4	13.1	8.2	34.3	27.1	15.2	....
	10″ up	221.3	188.4	117.7	97.5	77.0	43.1	....
Ironwood	4″–9″	7.1	6.1	3.8	1.1	0.9	0.5	....
	10″ up	9.1	7.7	4.8	1.3	1.0	0.6	....
Red oak	4″–9″	....	....	....	0.4	0.3	0.2	....
	10″ up	6.5	5.5	3.4	2.0	1.6	0.9	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar (all)	4″–9″	13.0	11.0	6.9	75.9	59.9	33.6	....
	10″ up	61.6	52.5	32.8	70.3	55.6	31.1	....
Black ash	4″–9″	12.0	10.2	6.4	13.5	10.6	6.0	....
	10″ up	4.2	3.6	2.2	5.7	4.5	2.5	....
White ash	4″–9″	0.9	0.8	0.5	1.2	0.9	0.5	....
	10″ up	5.6	4.7	3.0	8.4	6.7	3.7	....
Basswood	4″–9″	3.2	2.7	1.7	1.7	1.3	0.7	....
	10″ up	81.1	69.1	43.1	27.1	21.4	12.0	....
Black cherry	4″–9″	0.2	0.2	0.1	2.4	1.9	1.0	....
	10″ up	3.0	2.6	1.6	2.4	1.9	1.1	....
Total Hardwoods	4″–9″	127.4	108.5	67.8	237.6	187.4	105.1	....
	10″ up	864.7	736.2	460.0	325.7	257.5	144.0	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1593.2	1257.8	704.5	....
	10″ up	2247.3	1913.2	1195.8	803.8	635.2	355.5	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2397.0	1893.0	1060.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	0.5	0.4	0.3	2.9	2.4	1.5	2.3
	10″ up	11.1	9.5	6.0	3.7	3.2	2.0	19.0
White spruce	4″–9″	....	....	....	1.7	1.4	0.9	0.5
	10″ up	....	....	....	1.6	1.4	0.8	0.2
Balsam fir	4″–9″	....	....	....	5.9	5.0	3.1	1.6
	10″ up	....	....	....	0.7	0.6	0.4	0.3
Hemlock	4″–9″	12.5	10.6	6.7	7.7	6.5	4.1	10.2
	10″ up	48.3	41.1	26.2	12.0	10.2	6.4	26.6

Table 19 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White cedar	4″–9″	7.1	6.0	3.8	13.6	11.5	7.2	8.8
	10″ up	7.4	6.3	4.0	2.8	2.4	1.5	4.9
Larch	4″–9″	....	....	....	1.0	0.9	0.6	0.4
	10″ up	....	....	....	0.6	0.5	0.3	0.4
Total Conifers	4″–9″	20.1	17.0	10.8	32.8	27.7	17.4	23.8
	10″ up	66.8	56.9	36.2	21.4	18.3	11.4	51.4
Sugar maple	4″–9″	232.5	197.7	125.6	337.5	286.3	179.5	305.1
	10″ up	1073.9	913.1	580.2	181.7	154.2	96.7	438.8
Soft maple	4″–9″	29.3	24.9	15.8	86.1	73.0	45.8	55.1
	10″ up	130.0	110.6	70.3	47.0	39.9	25.0	105.1
White birch	4″–9″	8.5	7.3	4.6	72.2	61.3	38.4	13.5
	10″ up	8.9	7.5	4.8	14.9	12.6	7.9	15.1
Yellow birch	4″–9″	12.3	10.5	6.6	14.1	12.0	7.5	11.7
	10″ up	19.6	16.6	10.6	8.9	7.5	4.7	15.5
Beech	4″–9″	32.4	27.6	17.5	26.9	22.8	14.3	30.5
	10″ up	474.6	403.4	256.4	38.8	33.0	20.6	111.1
Elm	4″–9″	50.8	43.2	27.5	90.9	77.2	48.4	70.4
	10″ up	447.5	380.4	241.7	132.5	112.4	70.5	274.1
Ironwood	4″–9″	14.2	12.0	7.6	21.9	18.6	11.7	17.1
	10″ up	9.0	7.7	4.9	2.7	2.3	1.4	3.7
Red oak	4″–9″	0.8	0.7	0.4	34.7	29.5	18.5	8.3
	10″ up	16.6	14.1	9.0	22.8	19.3	12.1	44.5
White oak	4″–9″	....	....	....	0.9	0.8	0.5	0.7
	10″ up	2.9	2.5	1.6	0.7	0.6	0.4	3.1
Poplar (all)	4″–9″	6.5	5.6	3.5	210.2	178.3	111.8	30.2
	10″ up	25.4	21.5	13.7	79.0	67.0	42.0	55.0
Black ash	4″–9″	11.5	9.8	6.2	33.7	28.6	18.0	27.2
	10″ up	14.6	12.4	7.9	7.4	6.3	3.9	17.2
White ash	4″–9″	7.7	6.5	4.1	23.9	20.3	12.7	17.7
	10″ up	58.9	50.1	31.8	20.5	17.3	10.9	56.7
Basswood	4″–9″	11.7	9.9	6.3	22.2	18.8	11.8	13.9
	10″ up	98.4	83.7	53.1	37.0	31.4	19.7	58.5
Black cherry	4″–9″	4.1	3.4	2.2	13.9	11.8	7.4	6.2
	10″ up	7.5	6.4	4.1	5.8	4.9	3.1	10.8
Total Hardwoods	4″–9″	422.3	359.1	227.9	989.1	839.3	526.3	607.6
	10″ up	2387.8	2030.0	1290.1	599.7	508.7	318.9	1209.2
GRAND TOTAL	4″–9″	442.4	376.1	238.7	1021.9	867.0	543.7	631.4
	10″ up	2454.6	2086.9	1326.3	621.1	527.0	330.3	1260.6
TOTAL 4″ UP		2897.0	2463.0	1565.0	1643.0	1394.0	874.0	1892.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	11.0	9.4	5.9	5.7	4.8	3.1	18.1
	10″ up	208.5	178.2	112.7	24.8	21.2	13.6	69.7
White spruce	4″–9″	1.2	1.0	0.6	15.6	13.4	8.6	3.8
	10″ up	4.9	4.2	2.7	13.1	11.1	7.1	5.5
Balsam fir	4″–9″	11.8	10.1	6.4	75.8	64.6	41.3	18.2
	10″ up	6.5	5.5	3.5	10.4	8.9	5.7	4.8
Hemlock	4″–9″	123.5	105.5	66.8	37.8	32.2	20.6	68.1
	10″ up	458.9	392.3	248.1	48.4	41.3	26.4	112.9
White cedar	4″–9″	144.4	123.3	78.0	338.6	289.0	184.8	152.4
	10″ up	209.4	179.0	113.2	86.8	74.1	47.4	100.2
Larch	4″–9″	....	....	....	15.4	13.2	8.5	2.5
	10″ up	3.0	2.6	1.6	6.1	5.2	3.3	2.6
Total Conifers	4″–9″	291.9	249.3	157.7	488.9	417.2	266.9	263.1
	10″ up	891.2	761.8	481.8	189.6	161.8	103.5	295.7

Table 19 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	60.2	51.4	32.5	22.6	19.3	12.3	62.4
	10″ up	375.9	321.4	203.2	20.5	17.5	11.2	155.2
Soft maple	4″–9″	23.3	19.9	12.6	40.0	34.1	21.8	34.8
	10″ up	92.6	79.1	50.0	35.4	30.2	19.4	65.8
White birch	4″–9″	17.4	14.8	9.4	137.2	117.1	74.9	36.5
	10″ up	43.6	37.3	23.6	36.9	31.5	20.2	45.4
Yellow birch	4″–9″	47.6	40.7	25.7	42.2	36.0	23.0	34.9
	10″ up	138.4	118.3	74.8	38.6	33.0	21.1	55.7
Beech	4″–9″	17.8	15.2	9.6	2.8	2.4	1.5	13.2
	10″ up	299.3	255.8	161.8	6.1	5.3	3.4	76.3
Elm	4″–9″	34.2	29.2	18.5	77.5	66.2	42.3	72.4
	10″ up	398.7	340.9	215.5	170.2	145.2	92.9	337.9
Ironwood	4″–9″	8.6	7.4	4.6	6.3	5.3	3.4	6.6
	10″ up	6.6	5.6	3.6	0.9	0.8	0.5	0.5
Red oak	4″–9″	1.6	1.4	0.9	2.1	1.8	1.1	2.8
	10″ up	25.8	22.0	13.9	3.3	2.8	1.8	11.4
White oak	4″–9″	0.1	0.1	0.1	....	....	....	....
	10″ up	2.9	2.5	1.5	....	....	....	....
Poplar (all)	4″–9″	12.6	10.8	6.8	202.3	172.6	110.5	41.9
	10″ up	42.3	36.1	22.9	151.3	129.2	82.6	110.4
Black ash	4″–9″	21.1	18.1	11.4	47.6	40.7	26.0	21.5
	10″ up	12.4	10.6	6.7	8.0	6.8	4.4	14.0
White ash	4″–9″	7.8	6.6	4.2	6.8	5.8	3.7	9.3
	10″ up	28.8	24.7	15.6	7.6	6.5	4.1	13.2
Basswood	4″–9″	9.6	8.2	5.2	10.2	8.7	5.6	16.1
	10″ up	118.4	101.2	64.0	29.3	25.0	16.0	63.7
Black cherry	4″–9″	6.9	5.8	3.7	7.7	6.6	4.2	3.8
	10″ up	11.4	9.8	6.2	3.1	2.6	1.7	5.5
Total Hardwoods	4″–9″	268.8	229.6	145.2	605.3	516.6	330.3	356.2
	10″ up	1597.1	1365.3	863.3	511.2	436.4	279.3	955.0
GRAND TOTAL	4″–9″	560.7	478.9	302.9	1094.2	933.8	597.2	619.3
	10″ up	2488.3	2127.1	1345.1	700.8	598.2	382.8	1250.7
TOTAL 4″ UP		3049.0	2606.0	1648.0	1795.0	1532.0	980.0	1870.0

Notes

Notes

Hon. C. E. Mapledoram

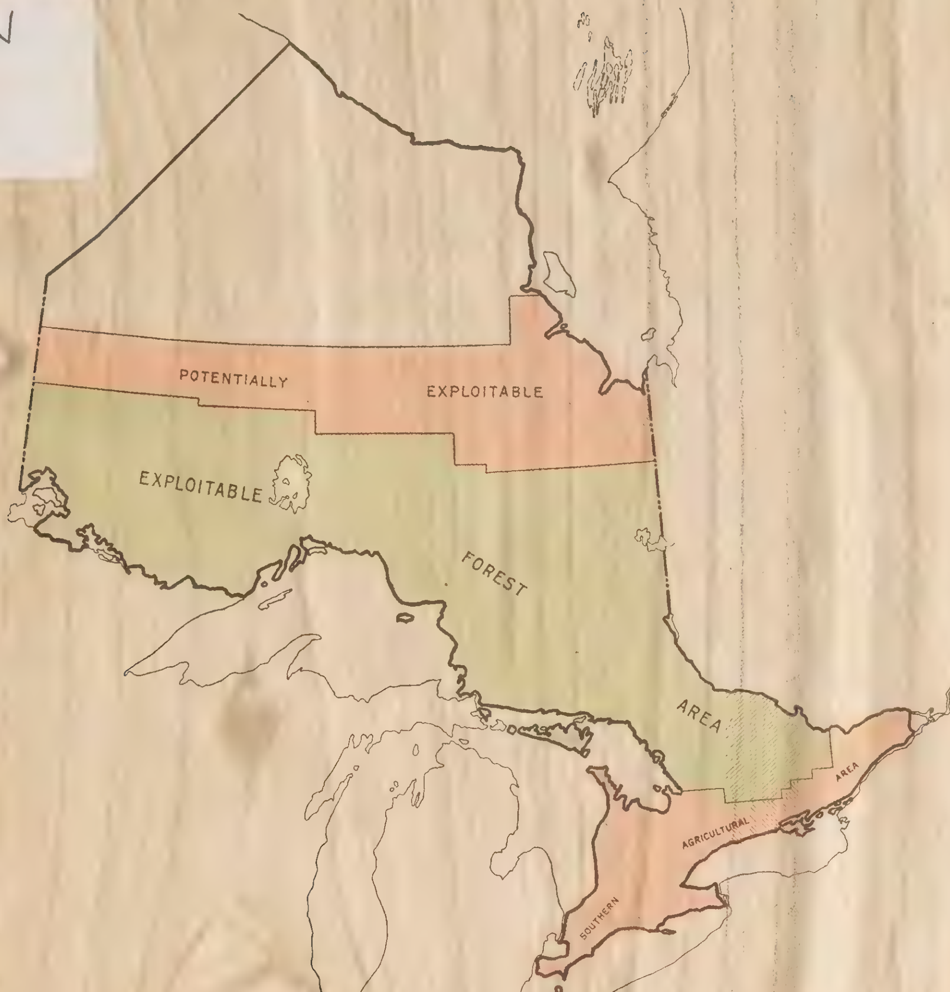
Minister

F. A. MacDougall

Deputy Minister

Report No. 20 of the

LAKE SIMCOE DISTRICT



Forest Resources Inventory

— 1957 —

Division of Timber Management

Ontario Department of Lands and Forests

Forest Resources Inventory

— 1957 —

Report No. 20 of the

LAKE SIMCOE DISTRICT

Division of Timber Management

Ontario Department of Lands and Forests

PREFACE

• In little more than a century, Southern Ontario has been transformed from an area of virgin forest into an agricultural and industrial region. The early settlers regarded the forest as an enemy that encroached upon the lands they required for farms and communities and formed a physical barrier between the isolated settlements. The abundance of wood and the scarcity of markets led to the belief that the supply of wood was inexhaustible. These attitudes, so inimical to forestry, persisted until recent times and, even now, have not completely disappeared.

Forests, mainly farm woodlots, now cover only a small portion of Southern Ontario and, in many places, are so reduced in size that they no longer fulfil many of their normal attributes. Historical evidence to prove the deterioration of soil and physical condition which follow on the destruction of forests is overwhelmingly conclusive. The process of deterioration is usually very similar. Forests are cleared for the expansion of agriculture or the exploitation of other resources, and the remaining forests are progressively degraded through unwise cutting, excessive grazing, and fires. On vulnerable soils and sites these practices lead to: cumulative erosion by wind and water; loss of the surface soil; deposition of erosion debris on fertile agricultural lands; reduction in water storage capacity; silting of irrigation works and the spread of aridity. The ultimate result of such a process is the destruction of the physical bases of life, the formation of deserts, and consequent social deterioration.

It is, therefore, no exaggeration to say that the reclamation of the unproductive and sub-marginal areas, and the preservation and improvement of existing woodlands, are matters of great importance to Ontario. The extension of the province-wide survey of the forest resources of Ontario to include these southern agricultural areas may be regarded as the first step in a programme of forest management and development.

The survey was authorized in 1952, and work was started by the Division of Timber Management early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement with the Province pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Department of Lands and Forests has set up twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the twentieth in the series, deals with the results of the inventory in the Lake Simcoe district.

CONTENTS

FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Lake Simcoe district, excluding 27,980 acres administered by the Federal Government, is 3,081,312 acres, or 4,815 square miles.

2. Inland waters, excluding the "Great Lakes," cover 243,892 acres, or 8 per cent of the total area. Lake Simcoe, the fourth largest inland lake in Ontario, covers 177,236 acres, or 73 per cent of the water area of the district.

3. The total land area of the district, including Federal lands, is 2,865,400 acres. Forested areas cover 21.1 per cent of the land area, and 69.3 per cent is devoted to agriculture. Other areas, which include Federal lands, towns, cities, roads, power lines, gravel-pits and railroads, account for the remaining 9.6 per cent.

4. The forested area has been classified as 80 per cent productive and 20 per cent non-productive. Agricultural areas are classed as 75 per cent developed agricultural land, 17 per cent grass and meadow land, and 8 per cent wooded pasture.

5. Patented land forms 88 per cent of the productive forest area within the district, while Crown lands account for 12 per cent. For the purposes of this report, forested areas administered under an agreement with the Minister of Lands and Forests, are classed as Crown lands.

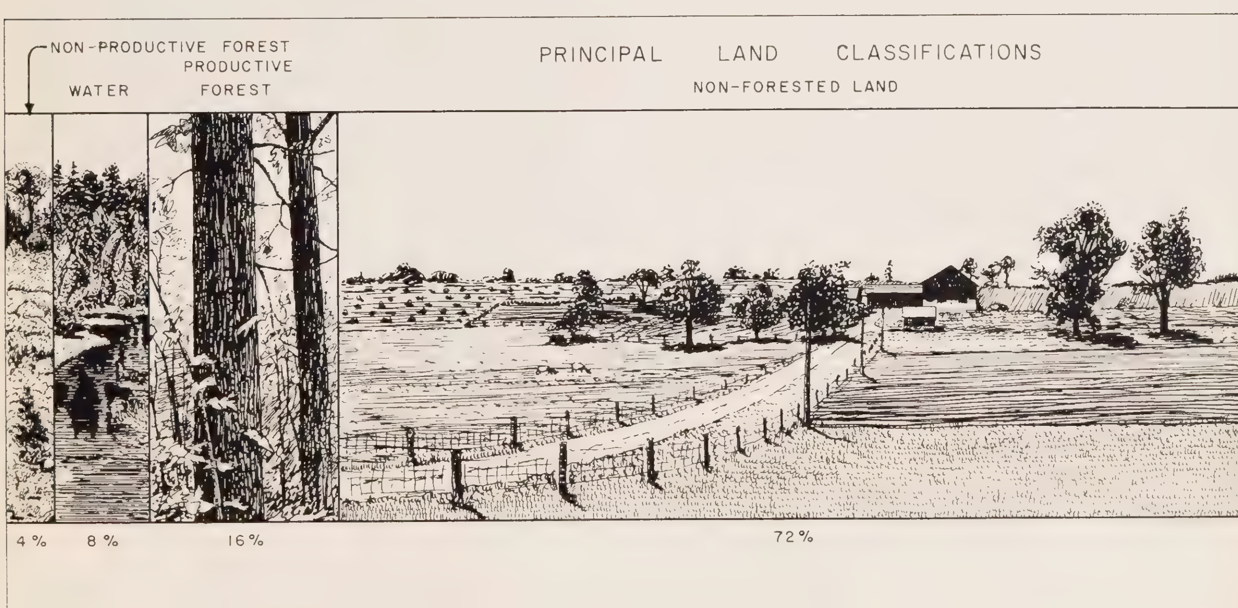
6. The age class distribution on productive forest lands shows: 9 per cent mature, 54 per cent immature, 11 per cent all-aged, 21 per cent young growth, and 5 per cent reproducing forest.

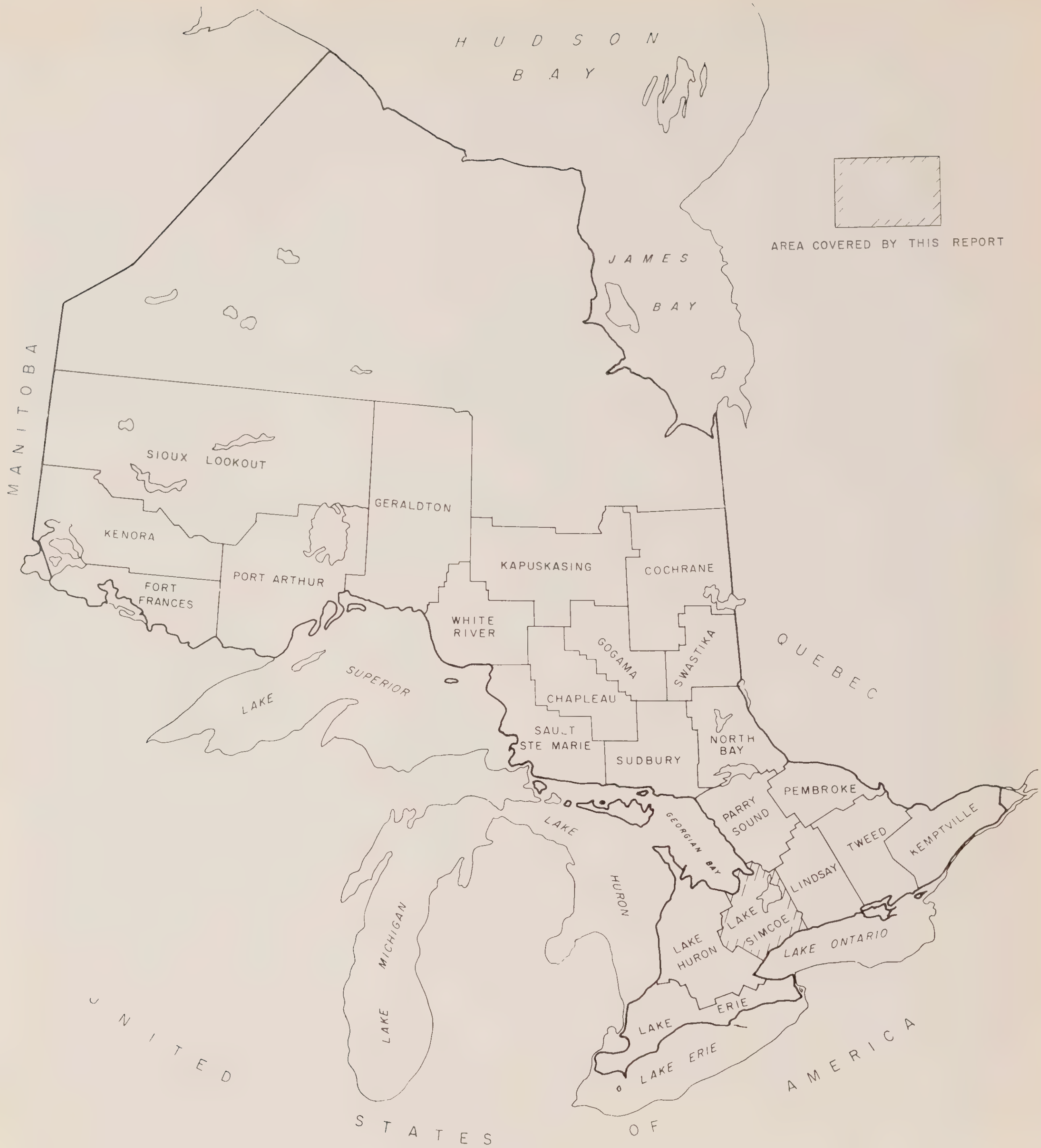
7. The hardwood cover type occupies 57 per cent of the productive forest land; the mixedwoods type occupies 32 per cent, and the coniferous type only 11 per cent.

8. The primary growing stock in the Lake Simcoe district is just over 506 million cubic feet and averages 1,047 cubic feet per acre. Hardwoods form 79 per cent and conifers 21 per cent of the total volume.

9. Sugar maple is the principal species in the Lake Simcoe district, comprising 22 per cent of the total growing stock. The next most prevalent species, by volume, are elm, poplar, white cedar and soft maple.

10. Forested areas within the district can support an annual cut of 12.8 million cubic feet. Hardwood species make up 85 per cent of the allowable cut.





MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Village of Maple, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Historical Background

• Because of raiding by the Iroquois, the native Indian tribes withdrew from the area between Lake Ontario and Lake Simcoe prior to the arrival of the earliest settlers. During the French Regime, little settlement occurred in this region, although trading posts were periodically established on the Humber River, which formed part of the overland route between Lake Ontario and Lake Huron.

York, later to be called Toronto, was founded by the British in 1793. By the middle of the nineteenth century, the southern watersheds were well populated. Numerous sawmills and gristmills were in operation on all the streams, the Humber alone supporting over 90 mills by 1860. As early as 1796 there was a road north to Holland Landing. Settlement crept slowly northward and thinly encircled Lake Simcoe, and by 1850 settlers were established between Lake Simcoe and Georgian Bay.

The Northern Railway was built from Toronto to Holland Landing and Allendale in 1853, and extended to Collingwood in 1855. The Midland Railway was built to Midland in 1875, connecting it with Port Hope. As a result of this construction, mills were built in the southern part of Simcoe County and on Lake Simcoe. The supply area being small, these mills remained in operation only a short time, reaching their peak about 1870, and then declining rapidly. In contrast, the northern part of the county remained an important lumber producer for many years.

Midland stood in a virgin forest in 1870, and the first mill was built there in 1872. In 1900 it was, next to Ottawa, the leading sawmilling centre in Canada. Collingwood, Penetanguishene, Victoria Harbour and Waubaushene also were important lumbering centres. When the excellent pine stands along the south shore of Georgian Bay were cut, these mills were able to draw on vast areas to the north. This normally transient industry was sustained for a long time by logs driven to the bay down the numerous streams flowing from the Muskoka and Parry Sound regions and by others rafted across Georgian Bay from Manitoulin Island and the north shore of Lake Huron.

New York and Chicago competed for the white pine from this region; and although Chicago was better situated in relation to the mills, the New York demand was so great that the pine continued to be shared between the two markets. Toronto and Port Hope were concentration points from which the lumber was trans-shipped to Oswego for Albany and New York. When the Erie Canal was freed of tolls in 1883, Georgian Bay lumber was shipped to Tonawanda and Buffalo by schooner, or by rail across Ontario, and Toronto ceased to be a lumber city of any importance.

The Lake Simcoe district now contains approximately one-third of Ontario's population, largely concentrated in the great industrial complex which extends along Lake Ontario westward from Oshawa. This development occurred originally because of the excellent transportation facilities and the cheap and plentiful supply of power, water, and suitable industrial land. It was further favoured by the presence of fine agricultural soils and a climate which permitted the development of the mixed farming and specialized agriculture required to maintain a modern urban society.

Within this district, the forested area is now restricted to the poorest sites. Hardwoods occur mainly in farm woodlots, while conifers appear mainly in plantations or on the rock outcrops in the northern part of the district. Although there is a ready market for forest products, including such specialized crops as Christmas trees, there is little possibility of the present forested areas being greatly increased in extent. In this district the production of wood fibre may be of secondary importance, and the chief value of forests may be in the provision of recreational areas, the prevention of erosion, the control of floods, and the maintenance of water levels.

White pine cones drying in trays.

Areas

The total area of the Lake Simcoe district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 3,081,312 acres (table 1), 4,815 square miles. This area is made up of 5 counties containing 45 townships, part of the District of Muskoka, and Metropolitan Toronto, which includes: the City of Toronto; the Towns of Leaside, Mimico, New Toronto and Weston; the Villages of Forest Hill, Long Branch and Swansea; and the Townships of Etobicoke, Scarborough, York, East York and North York.

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	58,470	425,184	483,654
Non-forested land[2]			
Developed agricultural land	2,555	1,491,697	1,494,252
Grass and meadow land	3,026	332,996	336,022
Non-reproducing burn	....	94	94
Wooded pasture	936	155,596	156,532
Unclassified land[3]	688	245,476	246,164
TOTAL	7,205	2,225,859	2,233,064
Non-productive forest[4]			
Open muskeg	2,634	13,576	16,210
Treed muskeg (scrub)	332	100	432
Brush, alder and flooded land	7,564	76,120	83,684
Rock outcrop	12,386	7,990	20,376
TOTAL	22,916	97,786	120,702
Water	243,892	....	243,892
TOTAL AREA	332,483	2,748,829	3,081,312

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

[2] Productive forest lands permanently withdrawn from timber production use.

[3] Lands occupied by roads, railroads, towns, etc.

[4] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity.

Within the district, inland waters, excluding the "Great Lakes," cover 243,892 acres, or 8 per cent of the total area. Lake Simcoe, the fourth largest of the inland lakes of Ontario, accounts for 73 per cent of the water area within the district. Productive forest lands occupy 483,654 acres, or 16 per cent of the total area (fig. 1). Non-productive forest lands, which appear to be permanently unfit for commercial timber production, owing to very low productivity, comprise 120,702 acres, or 4 per cent of the total area. Non-forested lands, which include areas permanently withdrawn from timber production, total 2,233,064 acres, or 72 per cent of the total area. Developed agricultural land, totalling 1,494,252 acres, comprises 67 per cent of the area within this classification (fig. 2). Grass and meadow land occupy 336,022 acres and 156,532 acres are classed as wooded pasture. These are low-density stands composed of a few large open-grown trees with wide-spreading crowns. In addition, there are 94 acres of non-reproducing burn and 246,164 acres of unclassified land occupied by cities, towns, villages, roads, railways, power lines, gravel-pits or otherwise withdrawn from forest production.

Cone-drying shed.

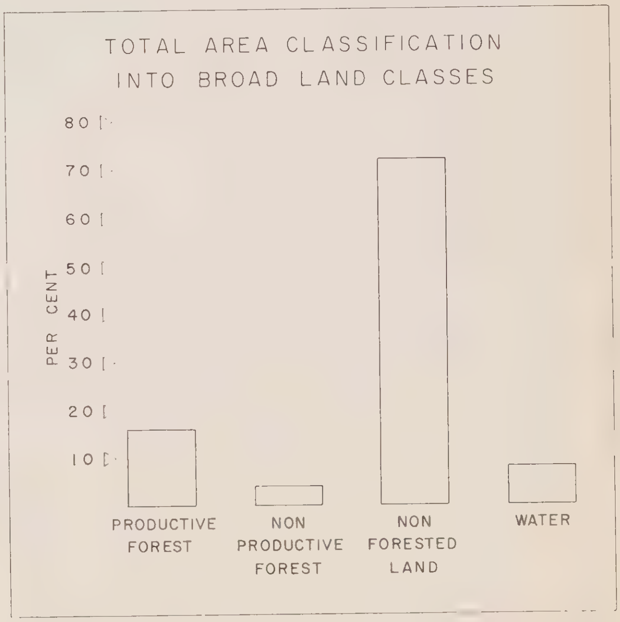


FIGURE 1

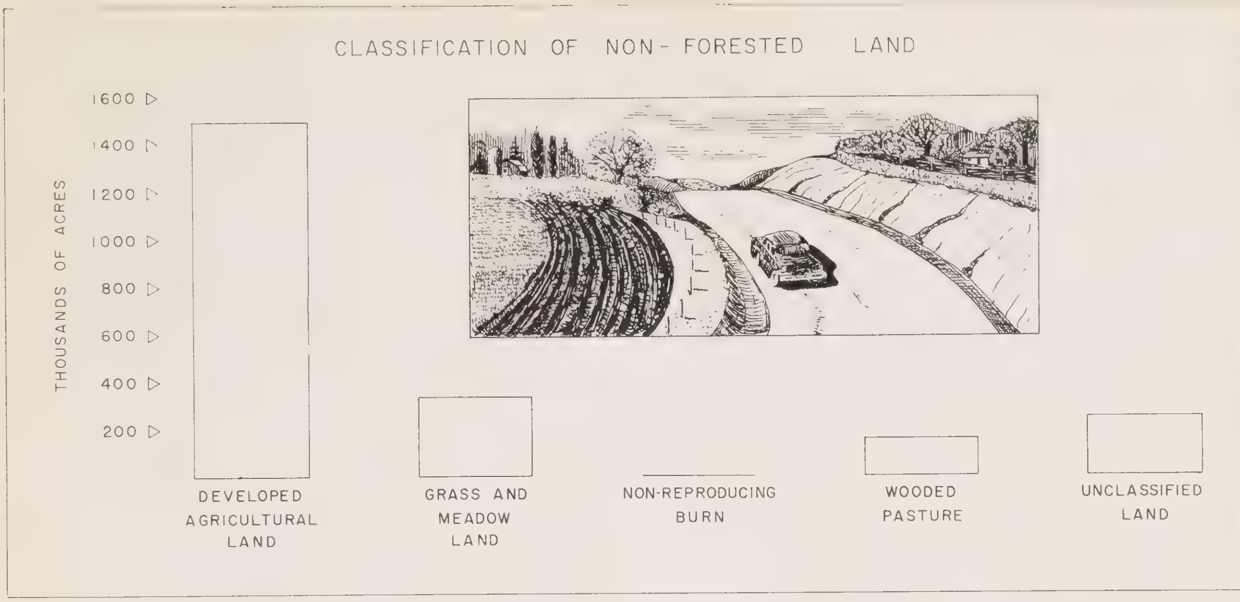


FIGURE 2

An analysis of the principal land classifications by counties (table 2) indicates that 76 per cent within the District of Muskoka contains productive forest land, amounting to 40,902 acres. The greatest area of productive forest land occurs in Simcoe County, where it totals 244,016 acres. This represents 23 per cent of the land area within Simcoe County, and accounts for 50 per cent of the productive forest land in the district. Peel County contains the smallest area of productive forest land within the district. The 25,372 acres in this classification represent nearly 9 per cent of the total land area in the county, and 5 per cent of the productive forest land in the Lake Simcoe district.

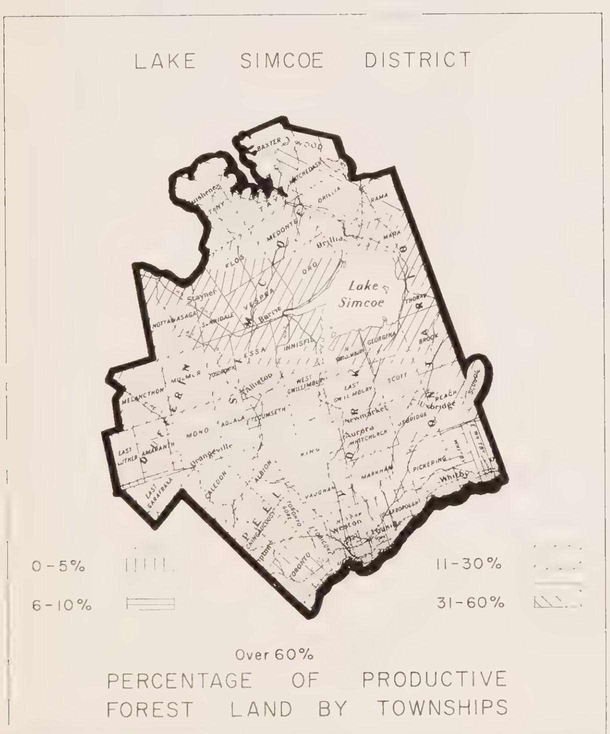


FIGURE 3

When the distribution of productive forest land is considered on a township basis (fig. 3), it is evident that the northern townships contain the greatest percentage within this classification. Productive forest land varies from a high of almost 82 per cent in Wood Township to less than one per cent in Toronto Gore Township.

Non-productive forest land, which occupies a relatively small area within the district, forms 30 per cent of Matchedash, 20 per cent of Baxter, and 17 per cent of Wood Township.

Agricultural land comprises 81 per cent of Peel County, 79 per cent of Dufferin County, 78 per cent of York County, 74 per cent of Ontario County and 66 per cent of Simcoe County. Metropolitan Toronto still has 28 per cent of its area classified as agricultural land, while the District of Muskoka contains only 3 per cent within this category.

Table 2. — *Principal land classifications by townships and counties — Lake Simcoe district.*

Township and county[1]	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agri-cultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas[2]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Amaranth	65,574	64,954	4,222	6.5	6,650	10.2	49,984	77.0	2,150	3.3	596	0.9	1,352	2.1
East Garafraxa	42,632	42,438	4,776	11.2	1,560	3.7	27,954	65.9	5,916	13.9	1,314	3.1	918	2.2
East Luther	40,000	39,324	1,874	4.8	4,538	11.5	29,962	76.2	1,170	3.0	954	2.4	826	2.1
Melancthon	77,016	76,282	8,244	10.8	7,718	10.1	55,326	72.5	2,356	3.1	1,218	1.6	1,420	1.9
Mono	70,030	69,392	10,918	15.7	2,078	3.0	36,998	53.3	13,958	20.1	3,886	5.6	1,554	2.3
Mulmur	70,160	69,306	14,174	20.4	714	1.0	37,336	53.9	11,602	16.8	4,222	6.1	1,258	1.8
Dufferin County	365,412	361,696	44,208	12.2	23,258	6.4	237,560	65.7	37,152	10.3	12,190	3.4	7,328	2.0
Baxter	40,432	33,052	23,934	72.4	6,574	19.9	378	1.1	1,188	3.6	102	0.3	876	2.7
Wood	23,330	20,818	16,968	81.5	3,526	16.9	....	....	220	1.1	....	....	104	0.5
Muskoka District[3]	63,762	53,870	40,902	75.9	10,100	18.8	378	0.7	1,408	2.6	102	0.2	980	1.8
Brock	69,192	68,570	9,338	13.6	5,238	7.7	41,320	60.3	7,160	10.4	3,364	4.9	2,150	3.1
East Whitby	35,876	35,362	1,360	3.8	438	1.3	15,058	42.6	9,240	26.1	2,090	5.9	7,176	20.3
Mara	63,718	61,882	15,316	24.8	2,258	3.7	30,592	49.4	8,686	14.0	3,366	5.4	1,664	2.7
Pickering	74,306	73,012	4,730	6.5	580	0.8	40,140	55.0	14,146	19.4	4,844	6.6	8,572	11.7
Rama	39,838	32,424	12,968	40.0	4,544	14.0	3,978	12.3	3,104	9.6	4,478	13.8	3,352	10.3
Reach	67,448	65,358	7,034	10.8	5,636	8.6	35,348	54.1	12,044	18.4	3,430	5.2	1,866	2.9
Scott	49,878	49,304	9,202	18.7	2,302	4.7	28,714	58.2	4,644	9.4	3,638	7.4	804	1.6
Scugog	16,518	11,234	1,468	13.1	1,204	10.7	4,636	41.3	2,306	20.5	510	4.5	1,110	9.9
Thorah	35,010	34,634	4,432	12.8	640	1.8	18,726	54.1	6,446	18.6	2,972	8.6	1,418	4.1
Uxbridge	52,364	52,028	8,824	17.0	476	0.9	26,790	51.5	13,150	25.3	1,428	2.7	1,360	2.6
West Whitby	36,202	35,542	2,030	5.7	470	1.3	20,246	57.0	7,374	20.7	2,022	5.7	3,400	9.6
Ontario County	540,350	519,350	76,702	14.8	23,786	4.6	265,548	51.1	88,300	17.0	32,142	6.2	32,872	6.3
Albion	58,062	57,488	5,948	10.4	716	1.2	33,356	58.0	12,488	21.7	3,092	5.4	1,888	3.3
Caledon	70,072	69,478	11,766	16.9	2,486	3.6	34,940	50.3	14,170	20.4	4,250	6.1	1,866	2.7
Chingaucousy	83,630	83,064	4,942	6.0	524	0.6	61,742	74.3	8,784	10.6	3,252	3.9	3,820	4.6
Toronto	67,686	67,104	2,538	3.8	140	0.2	36,274	54.1	6,738	10.0	1,648	2.4	19,766	29.5
Toronto Gore	19,428	19,020	178	0.9	....	....	14,888	78.3	2,294	12.1	690	3.6	970	5.1
Peel County	298,878	296,154	25,372	8.6	3,866	1.3	181,200	61.2	44,474	15.0	12,932	4.4	28,310	9.5
Adjala	45,696	45,340	5,612	12.4	630	1.4	24,550	54.2	10,306	22.7	3,180	7.0	1,062	2.3
Essa	69,110	68,812	9,356	13.6	1,130	1.6	40,726	59.2	5,460	7.9	3,832	5.6	8,308	12.1
Flos	69,330	68,296	13,606	19.9	2,790	4.1	40,766	59.7	5,820	8.5	3,388	5.0	1,926	2.8
Innisfil	70,752	70,422	10,266	14.6	1,878	2.7	43,888	62.3	5,904	8.4	2,984	4.2	5,502	7.8
Matchedash	52,126	47,736	27,292	57.2	14,356	30.1	3,290	6.9	1,042	2.2	1,202	2.5	554	1.1
Medonte	70,538	70,006	19,226	27.4	1,912	2.7	31,624	45.1	9,082	13.0	6,150	8.9	2,012	2.9
Nottawasaga	99,250	98,168	12,174	12.4	1,938	2.0	63,864	65.1	8,082	8.2	7,692	7.8	4,418	4.5
Orillia	87,118	79,406	28,220	35.5	6,616	8.3	23,856	30.0	8,378	10.6	7,198	9.1	5,138	6.5
Oro	78,458	77,138	19,216	24.9	1,416	1.9	40,066	51.9	10,544	13.7	3,180	4.1	2,716	3.5
Sunnidale	57,382	56,386	11,802	20.9	1,168	2.1	33,998	60.3	3,612	6.4	3,288	5.8	2,518	4.5
Tay	56,650	54,474	15,624	28.7	4,366	8.0	17,972	33.0	6,152	11.3	4,708	8.6	5,652	10.4
Tecumseth	70,296	69,704	4,664	6.7	642	0.9	50,840	72.9	7,424	10.6	3,950	5.7	2,184	3.2
Tiny	85,754	85,062	36,264	42.6	2,488	2.9	35,036	41.2	4,756	5.6	2,838	3.4	3,680	4.3
Tosorontio	45,430	45,282	6,546	14.4	442	1.0	19,158	42.3	3,296	7.3	1,816	4.0	14,024	31.0
Vespra	70,470	69,262	19,446	28.1	5,850	8.4	29,746	43.0	7,482	10.8	2,758	4.0	3,980	5.7
West Gwillimbury	52,856	52,170	4,702	9.0	2,654	5.1	34,356	65.8	6,394	12.3	2,190	4.2	1,874	3.6
Simcoe County	1,081,216	1,057,664	244,016	23.1	50,276	4.7	533,736	50.5	103,734	9.8	60,354	5.7	65,548	6.2

TABLE 2. — (*Cont'd*)

Township and county[1]	Total area	Total land area	Forested land				Agricultural land						Other areas[2]	
			Productive		Non-productive		Developed agricultural land		Grass and meadow		Wooded pasture			
	acres	acres	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent
East Gwillimbury	63,258	62,578	9,206	14.7	3,562	5.7	31,706	50.7	10,256	16.4	5,908	9.4	1,940	3.1
Georgina	40,246	39,836	9,396	23.6	2,182	5.5	14,256	35.8	5,792	14.5	3,274	8.2	4,936	12.4
King	91,422	90,672	8,986	9.9	2,434	2.7	55,066	60.7	14,398	15.9	6,476	7.1	3,312	3.7
Markham	69,272	68,384	2,642	3.9	32	....	49,706	72.7	3,990	5.8	3,624	5.3	8,390	12.3
North Gwillimbury	33,418	33,094	4,672	14.1	940	2.8	18,862	57.0	3,930	11.9	1,344	4.1	3,346	10.1
Vaughan	70,478	69,758	4,688	6.7	42	0.1	46,014	66.0	6,828	9.8	3,722	5.3	8,464	12.1
Whitchurch	64,132	63,242	10,226	16.2	94	0.1	33,562	53.1	11,806	18.7	3,696	5.8	3,858	6.1
YORK COUNTY	432,226	427,564	49,816	11.6	9,286	2.2	249,172	58.3	57,000	13.3	28,044	6.6	34,246	8.0
METROPOLITAN TORONTO	150,212	149,102	2,638	1.8	130	0.1	26,658	17.9	3,954	2.7	10,768	7.2	104,860	70.3
LAKE SIMCOE	177,236	....	....	....	....	.	....	.	....	.....	.	.	. .	
TOTAL — LAKE SIMCOE DISTRICT	3,109,292[4]	2,865,400[4]	483,654	16.9	120,702	4.2	1,494,252	52.1	336,022	11.7	156,532	5.5	274,144[4]	9.6

[1] Included under this heading are the District of Muskoka, Metropolitan Toronto, and Lake Simcoe.

[2] Other areas include all land administered by the Federal Government, as well as roads, railroads, cities, towns, villages, gravel-pits, etc.

[3] Muskoka District includes only those townships, or parts of townships, within the Lake Simcoe District.

[4] These totals include land areas administered by the Federal Government.

Forest Land Ownership

Settlement within this district was well-advanced by 1850, and the first settlers, who were primarily interested in agriculture, often burned the timber to clear the land. The Act of 1868 reserved pine trees on land located as free grants, but passed the pine trees to the grantee with the land when patent was issued. After 1880, however, it was the usual practice in Ontario to reserve pine timber to the Crown at the time patent was issued.

This reservation of pine trees continued through to 1937, except that in 1913 there was an amendment to The Public Lands Act which provided that where land was not in timber licence and the locatee was in residence with improvements he could request that pine trees be included in the patent, or in the event that patent had previously been issued, he could request a pine patent. The Public Lands Amendment Act, 1946, granted to the patentee all species of timber on land disposed of for agricultural purposes and patented prior to May 1, 1880. Subsequently, all pine reservations were removed from lands patented for agricultural purposes, regardless of the date of patent (Stat. 1951, chap. 71).

The Lake Simcoe district is essentially an area devoted to agriculture and urban development, and it is hardly surprising that only 3 per cent of the land area within this district is classified as Crown land. Of the total area of the Lake Simcoe district, 2,748,829 acres, or 89 per cent, is patented land and 88,591 acres, or 3 per cent, is Crown land; the balance of 243,892 acres, or 8 per cent, is water area. Considering the 483,654 acres of productive forest land, 425,184 acres, or 88 per cent, is patented land, and 58,470 acres, or 12 per cent, is Crown land.

For the purpose of this report, Crown lands include 20,913 acres of county forests and 2,089 acres of authority forests administered under the terms of legislation of the Forestry Act (Stat. 1952, chap. 32). This Act permits the Minister of Lands and Forests to enter into an agreement with the owners of lands that are suitable for forestry purposes for the reforestation and management of such lands for a stated period of years, which must not be less than twenty years.

Municipalities may, under the terms of The Trees Act (R.S.O. 1950, chap. 399), purchase land and either place the responsibility of reforestation and management in the hands of the Province through co-operative agreements, or carry out the planting and management of the forests without an agreement. The agreement provides that the Province will assume the responsibility for re-establishment and care of the forest for a stated period of years, usually fifty in recent agreements. At the end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price. Within the Lake Simcoe district, four counties — Simcoe, Dufferin, York and Ontario — have forests under agreement with the Crown.

Simcoe County established the first county forest in Ontario in 1922. At the present time there are five county forests — Angus, Drury, Hendrie, Orr Lake, and Wildman — totalling 13,846 acres, within Simcoe County. This district also contains the Dufferin County Forest of 2,042 acres, the Vivian Forest in York County which contains 3,472 acres, and the Uxbridge Forest of 1,553 acres in Ontario County.

The Conservation Authorities Act (R.S.O. 1950, chap. 62) permits the authority to enter into an agreement with the Minister of Lands and Forests for the administration of Authority Forests. These agreements are similar, although not identical, to those entered into by the municipalities and the Crown. The Grand Conservation Authority was established in 1948 and the Grand Authority Forest, which includes 1,073 acres within the Lake Simcoe district, is administered under an agreement. The Humber Valley Conservation Authority was incorporated in 1948 and the Humber Forest, which at present has an area of 1,016 acres, was started in 1951. This Authority, along with the Etobicoke-Mimico, Don, and R.D.H.P. Conservation Authorities, was incorporated into the Metropolitan Toronto and Region Conservation Authority on February 1, 1957, under an amendment to the Conservation Authorities Act.

The relatively small area of Crown land within this district includes a provincial forest tree nursery, established at Midhurst in 1922; a seed extraction plant, established at Angus in 1923; and the Southern Research Station located 18 miles north of Toronto, near Maple. This 100-acre property contains the Lake Simcoe district office, the central radio station of the Department, storage sheds, a storage vault for records, a limnology laboratory for fisheries research, a biological research building, and a greenhouse for tree breeding and silvicultural research.

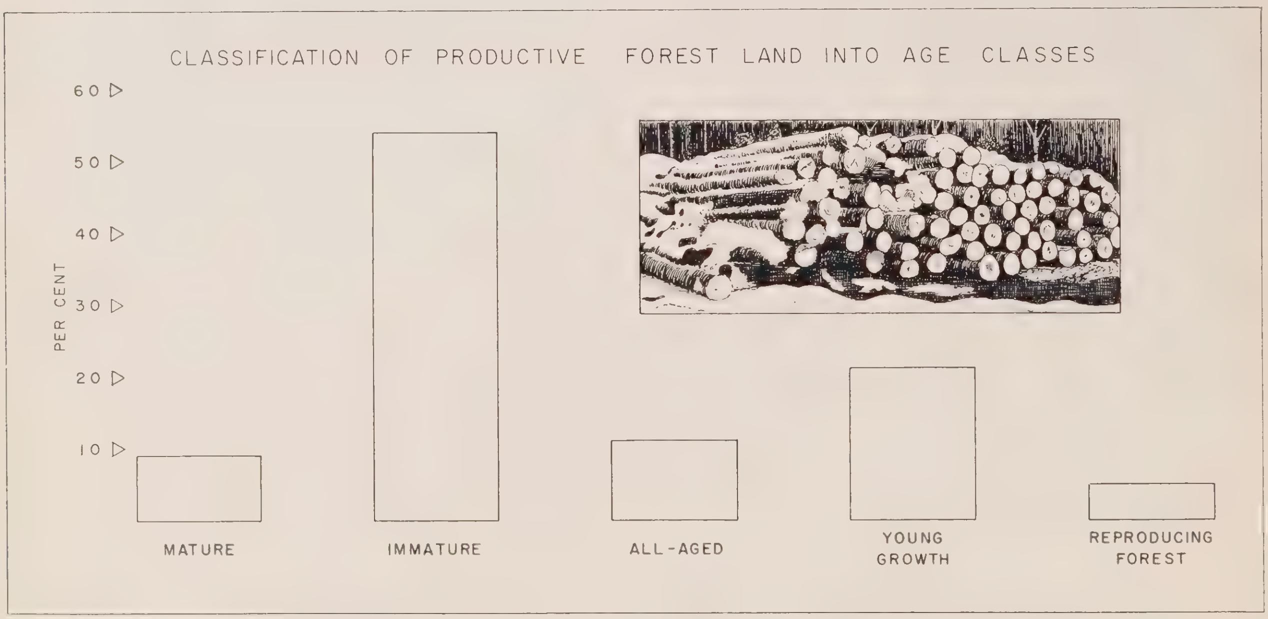


FIGURE 4

A modern forest pathology laboratory was completed at Maple in 1953. This building is provided and maintained by the Department of Lands and Forests as its part in a co-operative scheme directed towards the prevention or control of tree diseases. The laboratory is administered by the Forest Biology Division of The Science Service, Department of Agriculture, Canada.

Spreading straw or mulch onto seed bed.

Age Classes

A forest, to produce sustained timber yields, should be made up of trees of all age classes and stages of development from seedlings to mature timber, in such proportions that when one group of trees is harvested, another is ready to take its place.

The total productive forest area of the Lake Simcoe district is classed as 9 per cent mature, 54 per cent immature, 11 per cent all-aged, 21 per cent young growth, and 5 per cent reproducing forest (table 3, fig. 4).

Patented lands, totalling 425,184 acres, or 88 per cent of the productive forest area, have a similar distribution with 10 per cent mature, 58 per cent immature, 11 per cent all-aged, 18 per cent young growth, and 3 per cent reproducing forest.

On Crown lands, mature forest occupies 5 per cent of the area; immature, 31 per cent; all-aged, 6 per cent; young growth, 40 per cent; and reproducing forest, 18 per cent. Crown lands occupy only 58,470 acres, or 12 per cent of the productive forest area.

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	14	1,398	1,412	*
Hardwood	2,198	32,170	34,368	7
Mixedwoods	500	8,544	9,044	2
TOTAL	2,712	42,112	44,824	9
Immature forest:				
Coniferous	356	20,604	20,960	4
Hardwood	9,358	133,150	142,508	29
Mixedwoods	8,716	91,176	99,892	21
TOTAL	18,430	244,930	263,360	54
All-aged forest:				
Hardwood	968	32,548	33,516	7
Mixedwoods	2,270	15,000	17,270	4
TOTAL	3,238	47,548	50,786	11
Young growth:				
Coniferous	158	5,354	5,512	1
Hardwood	21,814	45,804	67,618	14
Mixedwoods	1,450	25,796	27,246	6
TOTAL	23,422	76,954	100,376	21
Reproducing forest	10,668	13,640	24,308	5
TOTAL PRODUCTIVE FOREST	58,470	425,184	483,654	100

*Less than one per cent.

Regional Forest Types

The Lake Simcoe district lies mainly within the Great Lakes-St. Lawrence Forest Region, although the southwestern section falls in the Deciduous Forest Region. The Great Lakes-St. Lawrence Region is centered on the Great Lakes system. The indicating species are sugar maple and yellow birch. White pine and red maple have a wide distribution, while hemlock and beech are present in much of the region. Within this district, the forests have been greatly modified by settlement, lumbering, and subsequent reforestation.

Separate volume and yield tables are prepared for each region, or section, and they serve as units in the compilation of volume estimates. In the Lake Simcoe district three forest sections are represented (fig. 5) as follows:

1. The Algonquin section includes the three most northerly townships and covers 4 per cent of the area.

2. The Huron section covers almost the entire district, or 88 per cent of the area.

3. The Niagara section occurs in the southwest corner of the district, occupying 8 per cent of the area.

The Algonquin section has a bedrock of crystalline limestones, schists and gneisses of the Precambrian Shield. Topography is rough and irregular with numerous lakes and streams. Glacial deposits, of varied character and a light texture, cover most of the region. It is an area of mixed forest in which sugar maple, yellow birch, hemlock, and white pine predominate. The mature forest is at present almost non-existent, and second growth stands of hardwoods and mixedwoods occupy most of the area. These associations contain a variety of species, but aspen, red oak, soft maple, sugar maple, white oak, basswood, hemlock and white pine occur frequently.

The Huron section is underlain by the Ordovician and Silurian rocks of the Palaeozoic Era. These consist of limestone, shale, sandstone and dolomite, overlain by glacial material which is modified, in part, by wave action and lacustrine deposits. The prevailing association is a broad-leaved forest, in which sugar maple and beech are dominant. Hemlock, white pine, oak, elm, basswood, ash, red maple, hickory, ironwood and black cherry all occur within the association. The area is heavily settled, and the forested area has been both reduced in extent and altered in composition.

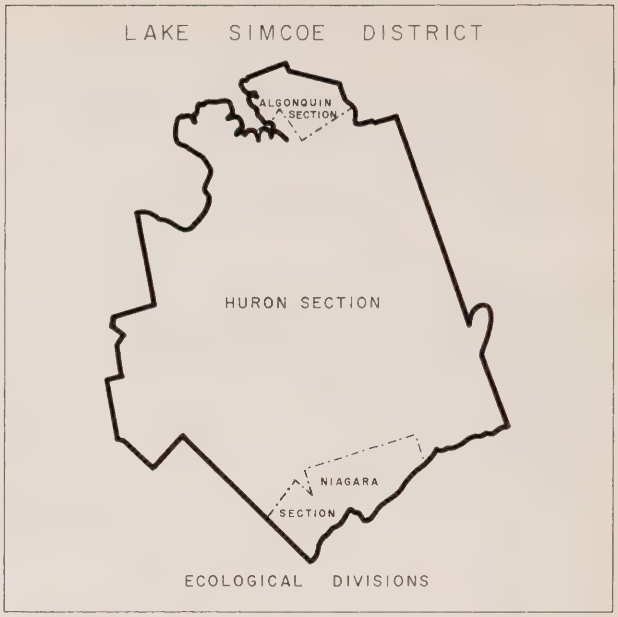


FIGURE 5

The Niagara section is composed predominantly of broad-leaved trees. A large number of species, many of small size, find their northern range here. Within this district, the section occurs in an area that is largely urban. Therefore, the volumes for any forested areas have been calculated from tables for the Huron section.

Forest cover, within these broad regions, is influenced by local climate, together with the soil and rock materials. The following local land forms, or minor physiographic regions[1] (fig. 6), have been recognized:

1. *Niagara Escarpment.* — This escarpment enters the district in Caledon Township and runs northward to the Blue Mountains near Collingwood. The uniform slopes of the escarpment are mantled by morainic deposits which, through much of this section, completely hide it. The slopes are dissected by deep valleys and the easily eroded land is badly gullied.

2. *Horseshoe Moraines.* — The eastern arm of this formation straddles the escarpment. It has two main components, — the irregular, stony knobs and ridges, and the gravel or swamp-floored valleys. The sandy terraces are unconfined by moraine on the east and are badly gullied. The drift and terraces are an important source of gravel.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951.

FIGURE 6

3. *Dundalk Till Plain.* — This gently undulating plain is characterized by swamps, bogs, and poorly drained depressions. A superficial silt deposit overlies the pebbly loam. This region has the coolest and shortest growing season of any farming area in Southern Ontario.

4. *Stratford Till Plain.* — A faint knoll and sag relief is apparent on this plain, formed of brown calcareous silty clay.

5. *Hillsburg Sand Hills.* — The characteristic feature is rough topography with flat-bottomed swampy valleys. Fine sands are prevalent, and the soils on the steeper slopes are droughty and erosive.

6. *Guelph Drumlin Field.* — The drumlins are broad and oval with moderate slopes. They are not too closely grouped, and the intervening low ground is occupied by alluvial materials.

7. *Oak Ridges.* — This interlobate moraine extends across the district from the Niagara escarpment to Lake Scugog. It is the divide between the Lake Ontario and Georgian Bay-Trent River drainage systems. Water tends to drain vertically through the sand and gravel and, although it is the source of many streams, there is a lack of water in the moraine. The soil is unstable under cultivation, although the gentler slopes may be pastured and cropped, depending on the slope and texture. Plantations at Vivian demonstrate the effectiveness of reforestation in stabilizing the hilly, sandy soil which is subject to wind erosion.

8. *South Slopes.* — This moraine contains a variety of soils, some of which are excellent. The shale content increases from east to west and the topography changes from a drumlinized area to a faintly drumlinized till plain in the central portion. The western section, which is morainic, is split by the Peel Plain.

9. *Peel Plain.* — A heavy-textured clay soil occupies this level to undulating tract through which streams have cut deep valleys. Owing to the high degree of evaporation from the clay and the fact that the underlying shales are not good aquifers, the water supply is a problem in this area.

10. *Iroquois Plain.* — This narrow area bordering Lake Ontario is now mainly converted to urban land uses. Varied conditions occur in this section. Ontario County contains drumlins and clay plains; Scarborough Township has high bluffs, standing up to 350 feet above the lake; while a narrow, sloping, well-drained plain — formerly an important horticultural area — occurs west of Toronto.

11. *Schomberg Clay Plains.* — Deep deposits of stratified clay and silt occupy depressions along the northern slope of the Oak Ridges moraine. The largest areas are located near Schomberg, Newmarket, and Lake Scugog. The Scugog area is underlain by a flat till plain, while the two western areas, which are underlain by an incompletely buried, drumlinized till plain, are not as flat as many lake plains.

12. *Peterborough Drumlin Field.* — A wide variety of soil types occur in this area, which is noted for its drumlins and eskers. The till plain is dissected by a series of deep valleys with wide, swampy bottoms and sluggish streams. Utilization of the land is handicapped by steep slopes, stoniness, and wet swampy hollows.

13. *Simcoe Lowlands.* — The western portion draining into Nottawasaga Bay and the eastern section surrounding Lake Simcoe are joined at Barrie by a flat-floored valley. The western part is divided into several distinctive sections: poorly drained flats, sand plains, clay plains, and the sand beaches bordering Georgian Bay. A narrow, bouldery terrace forms the northern and western shores of Lake Simcoe. Cold, wet, subsoils occur in a broad valley which extends fifteen miles south

of the lake and forms the Holland Marsh and Queensville flats. Northeast of this area is a low, swampy sand plain, modified at the north by several nearly bare tracts of limestone. North of this again is a clay plain.

14. *Simcoe Uplands.* — The undulating topography is formed by a series of ridges separated by steep-sided, flat-floored valleys. Till is composed mainly of Precambrian rock, and the dominant soil is a well-drained stony, or sandy, loam.

15. *Carden Plain.* — This limestone plain, with little overburden, once supported a good pine forest. Most of the settled land is now utilized as rough pasture.

Cover Types

The forests of the Lake Simcoe district contain 22 native species, or species groups, which occur in sufficient volume to be incorporated into this report. Additional species, such as walnut, butternut, sycamore and hickory, have a very scattered representation and Scots pine, jack pine, European larch and Norway spruce have been introduced in plantations within the district.

The forests of the district are described under three main cover types: coniferous, hardwood, and mixedwoods. The coniferous type is one in which 75 per cent or more of the number of trees are conifer or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or

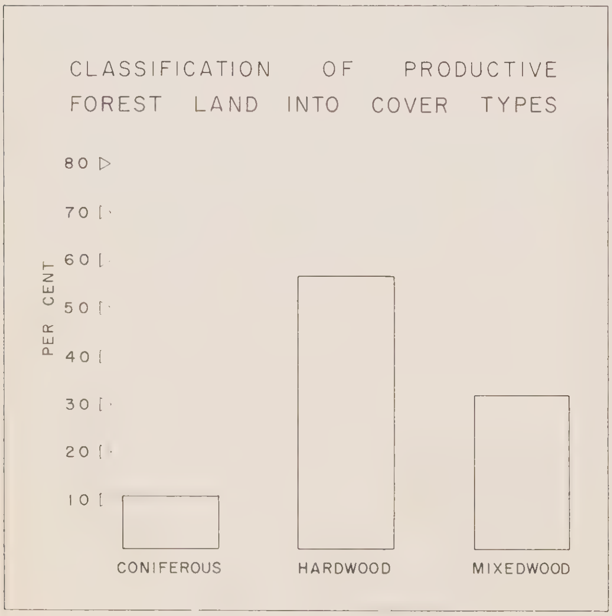


Figure 7

Table 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	14	*	1,398	*	1,412	*
Immature	356	1	20,604	5	20,960	5
Young growth	158	*	5,354	1	5,512	1
Plantations	10,640	18	12,674	3	23,314	5
Total	11,168	19	40,030	9	51,198	11
Hardwood type:						
Mature	2,198	4	32,170	8	34,368	7
Immature	9,358	16	133,150	31	142,508	29
All-aged	968	2	32,548	8	33,516	7
Young growth	21,814	37	45,804	11	67,618	14
Plantations	....	....	2	*	2	*
Total	34,338	59	243,674	58	278,012	57
Mixedwoods type:						
Mature	500	1	8,544	2	9,044	2
Immature	8,716	15	91,176	21	99,892	21
All-aged	2,270	4	15,000	4	17,270	3
Young growth	1,450	2	25,796	6	27,246	6
Plantations	....	–	....	....	....	....
Total	12,936	22	140,516	33	153,452	32
Reproducing forest	28	*	964	*	992	*
TOTAL PRODUCTIVE FOREST	58,470	100	425,184	100	483,654	100

*Less than one per cent.

broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there are small areas of recently established natural reproduction that have not yet attained a sufficiently stable composition to be classified into cover types. The artificially established plantations are areas of reproduction which have been classified according to cover type.

The hardwood type occupies 57 per cent of the productive forest land (table 4); the mixedwoods type covers 32 per cent, and the coniferous type only 11 per cent (fig. 7). The distribution on patented land varies only slightly from these figures.

On Crown land, the hardwood type occurs on 59 per cent of the productive forest area, the mixedwoods type on 22 per cent, and the coniferous type on 19 per cent.

Plantations comprise 95 per cent of the coniferous type on Crown land and 32 per cent of this type on

patented lands. On Crown lands the principal species planted are the four pines — red, Scots, jack, and white — while smaller quantities of European larch, white and Norway spruce, and white cedar are also planted. Private plantations consist primarily of Scots pine grown for Christmas trees, although relatively small quantities of red, jack, and white pine are also planted.

There are 10,640 acres of coniferous plantations on Crown lands within the district. Plantations on patented land total 12,676 acres, of which two acres have been classified as mixedwood, while the remainder are coniferous.

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average Total
	4″–9″ d.b.h.	10″ up d.b.h.	Average total	4″–9″ d.b.h.	10″ up d.b.h.	Average total	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	390	985	1,375	366	1,797	2,163	2,115
Immature	631	427	1,058	754	461	1,215	1,204
All-aged	621	1,105	1,726	627	1,248	1,875	1,866
Productive forest	251	241	492	541	583	1,124	1,047

The volume of the primary growing stock on productive forest lands in the Lake Simcoe district is just over 506 million cubic feet (506,624,000 cubic feet). This is an average of 1,047 cubic feet per acre (table 5). The mature age class contains 94.8 million cubic feet (table 6), or 2,115 cubic feet per acre; the immature age class contains 317.1 million cubic feet, or 1,204 cubic feet per acre; and the all-aged stands contain 94.7 million cubic feet, or 1,866 cubic feet per acre.

Crown lands in the Lake Simcoe district have a total volume just under 29 million cubic feet (table 7), or an average of 492 cubic feet per acre. This low volume is due to the fact that only 42 per cent of the productive forest on Crown lands supports trees of talliable size, 3.6 inches d.b.h. and over. The remaining areas contain artificial or natural

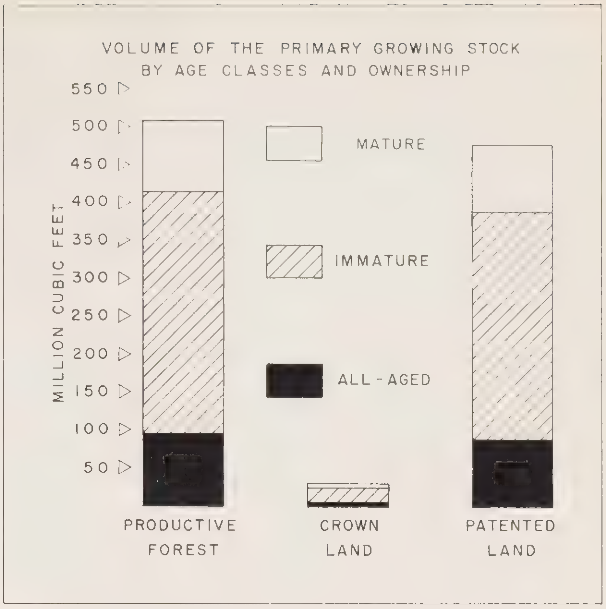


FIGURE 8

regeneration, and young growth that is too small to contribute any volume to the present calculations. The mature age class contains 3.7 million cubic feet, or 1,375 cubic feet per acre; the immature, 19.5 million cubic feet, or 1,058 cubic feet per acre; and the all-aged stands, 5.6 million cubic feet, or 1,726 cubic feet per acre.

Patented lands within the district have a primary growing stock of almost 478 million cubic feet (table 8), averaging 1,124 cubic feet per acre. The mature age class totals 91.1 million cubic feet, or 2,163 cubic feet per acre; the immature age class contains 297.6 million cubic feet, or 1,215 cubic feet per acre; and all-aged stands contain 89.2 million cubic feet (fig. 8), or 1,875 cubic feet per acre.

Sanding beds after seeding operation.

Table 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Lake Simcoe district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,042	2,354	21,685	10,902	....	....	35,983
Hardwood	11,629	59,664	104,391	63,557	21,129	42,000	302,370
Mixedwoods	3,808	16,321	70,282	46,243	10,702	20,915	168,271
Total	16,479	78,339	196,358	120,702	31,831	62,915	506,624

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	909	1,448	18,467	6,483	....	....	27,307
Hardwood	798	2,568	3,716	2,933	902	1,958	12,875
Mixedwoods	1,915	6,002	30,895	15,540	4,517	6,106	64,975
Total	3,622	10,018	53,078	24,956	5,419	8,064	105,157

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	133	906	3,218	4,419	....	....	8,676
Hardwood	10,831	57,096	100,675	60,624	20,227	40,042	289,495
Mixedwoods	1,893	10,319	39,387	30,703	6,185	14,809	103,296
Total	12,857	68,321	143,280	95,746	26,412	54,851	401,467

Table 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Simcoe district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	311	111	....	....	422
Hardwood	857	2,044	6,171	3,799	600	1,135	14,606
Mixedwoods	200	628	5,148	3,959	1,410	2,442	13,787
Total	1,057	2,672	11,630	7,869	2,010	3,577	28,815

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	279	65	....	....	344
Hardwood	190	578	359	446	59	130	1,762
Mixedwoods	74	295	2,021	2,731	582	1,252	6,955
Total	264	873	2,659	3,242	641	1,382	9,061

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	32	46	....	....	78
Hardwood	667	1,466	5,812	3,353	541	1,005	12,844
Mixedwoods	126	333	3,127	1,228	828	1,190	6,832
Total	793	1,799	8,971	4,627	1,369	2,195	19,754

TABLE 8. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Simcoe district by species group, age class and cover type in two size classes.*

ALL SPECIES

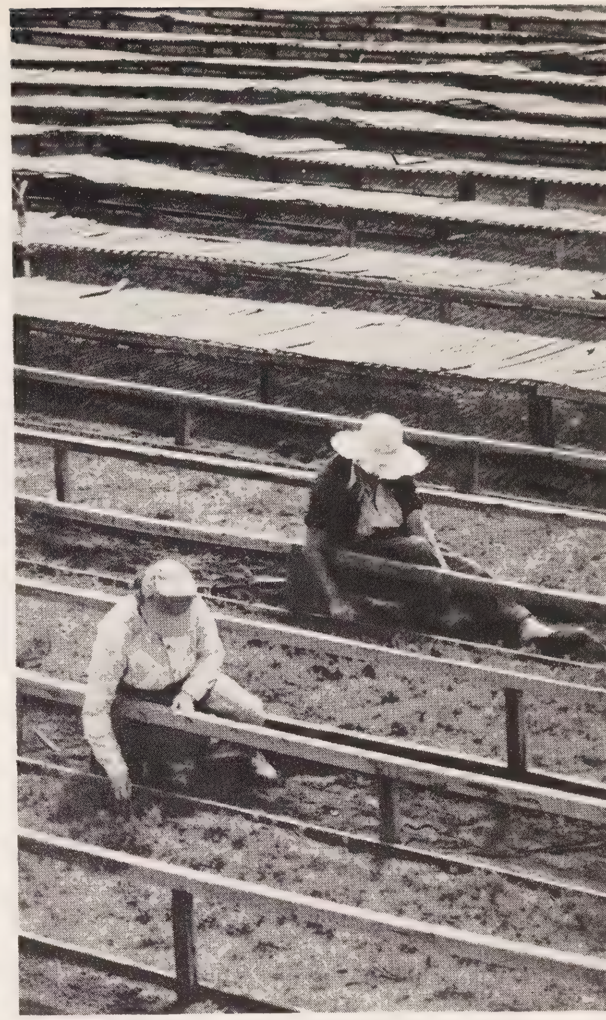
Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,042	2,354	21,374	10,791	....	....	35,561
Hardwood	10,772	57,620	98,220	59,758	20,529	40,865	287,764
Mixedwoods	3,608	15,693	65,134	42,284	9,292	18,473	154,484
TOTAL	15,422	75,667	184,728	112,833	29,821	59,338	477,809

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Tyousand cu. ft.*	*Thousand cu. ft.*
Coniferous	909	1,448	18,188	6,418	....	....	26,963
Hardwood	608	1,990	3,357	2,487	843	1,828	11,113
Mixedwoods	1,841	5,707	28,874	12,809	3,935	4,854	58,020
TOTAL	3,358	9,145	50,419	21,714	4,778	6,682	96,096

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	133	906	3,186	4,373	....	....	8,598
Hardwood	10,164	55,630	94,863	57,271	19,686	39,037	276,651
Mixedwoods	1,767	9,986	36,260	29,475	5,357	13,619	96,464
TOTAL	12,064	66,522	134,309	91,119	25,043	52,656	381,713



Weeding the seedling beds.

Species

Within the Lake Simcoe district the hardwood species total 401 million cubic feet (table 9), or 79 per cent of the volume, and the coniferous species total 105 million cubic feet, or 21 per cent of the volume.

Nine species form 82 per cent of the volume on productive forest land (fig. 9). The principal species within the district is sugar maple, which comprises 22 per cent of the total growing stock. It is followed by elm with 13 per cent, poplar 13 per cent, white cedar 10 per cent, soft maple 6 per cent, white birch and beech with 5 per cent each, and hemlock and white pine with 4 per cent each. Thirteen species form the remaining 18 per cent of the total growing stock.

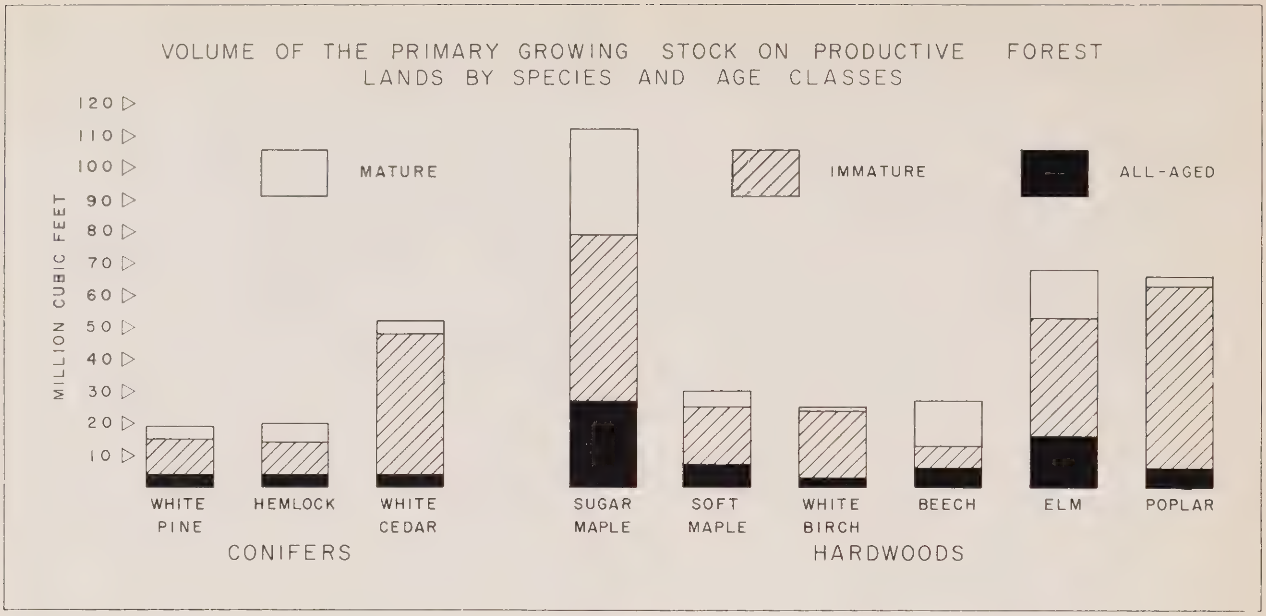


FIGURE 9

In the mature age class three species — sugar maple 35 per cent, beech and elm 15 per cent each — form 65 per cent of the volume. Four species make up 61 per cent of the immature volume; poplar 18 per cent, sugar maple 17 per cent, white cedar 14 per cent, and elm 12 per cent. In the all-aged stands, sugar maple forms 28 per cent of the volume and elm 17 per cent.

Crown lands have almost 29 million cubic feet (table 10), of which 31 per cent is made up by conifers and 69 per cent by hardwoods. The principal species are poplar and white pine, each of which forms 22 per cent of the total volume. These two species are the principal components in all age classes, followed by red oak and sugar maple in the mature and immature stands, and by red oak and hemlock in the all-aged stands.

Patented lands, which support 94 per cent of the wood volume in the district, have 96 million cubic feet of conifers and 382 million cubic feet of hardwoods (table 11). Sugar maple, elm, poplar, and white cedar are the principal species on patented lands. Sugar maple forms 36 per cent of the mature age class, followed by elm 16 per cent and beech 15 per cent. Four species, sugar maple, poplar, white cedar, and elm, form 60 per cent of the immature volume. In the all-aged stands, sugar maple comprises 30 per cent of the volume and elm 18 per cent.

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4–9 inches d b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material, depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in

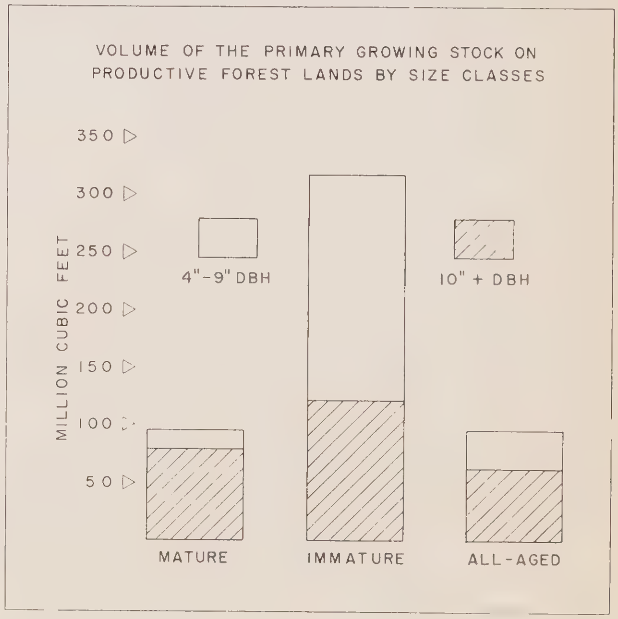


FIGURE 10

Table 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Lake Simcoe district by species and age class in two size classes.*

Species	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″–9″ d.b.h.	All-aged 10″ up d.b.h.	Total all lands
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	489	3,154	3,192	7,938	744	3,348	18,895
Red pine	5	....	56	43	13	40	157
White spruce	10	44	1,528	1,165	75	95	2,917
Black spruce	....	....	78	....	....	....	78
Balsam fir	112	61	7,099	995	543	74	8,884
Hemlock	1,214	4,353	4,563	5,660	1,606	2,927	20,323
White cedar	1,791	2,381	34,929	8,616	2,362	1,532	51,611
Larch	1	25	1,633	539	46	48	2,292
Total Conifers	3,622	10,018	53,078	24,956	5,419	8,064	105,157
Sugar maple	5,778	27,379	33,593	18,936	10,621	16,223	112,530
Soft maple	856	3,654	11,521	6,965	2,606	4,602	30,204
White birch	804	495	17,001	3,883	1,237	1,272	24,692
Yellow birch	616	1,434	4,319	3,591	874	1,286	12,120
Beech	869	12,975	2,702	4,143	1,200	4,657	26,546
Elm	1,405	13,058	13,624	23,656	3,183	13,122	68,048
Ironwood	460	260	2,552	322	654	122	4,370
Red oak	344	974	6,162	3,645	832	2,587	14,544
White oak	160	299	1,102	460	288	327	2,636
Poplar	445	2,480	36,744	19,737	1,927	4,483	65,816
Black ash	410	419	6,296	1,301	1,178	726	10,330
White ash	226	1,549	2,741	2,487	678	1,944	9,625
Basswood	332	3,096	3,148	5,869	882	3,089	16,416
Black cherry	152	249	1,775	751	252	411	3,590
Total Hardwoods	12,857	68,321	143,280	95,746	26,412	54,851	401,467
TOTAL ALL SPECIES	16,479	78,339	196,358	120,702	31,831	62,915	506,624

Table 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Simcoe district by species and age class in two size classes.*

Species	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″–9″ d.b.h.	All-aged 10″ up d.b.h.	Total Crown land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	211	790	1,244	2,786	237	983	6,251
Red pine	2	....	31	24	7	23	87
White spruce	....	1	21	16	5	9	52
Black spruce	....	....	72	....	....	....	72
Balsam fir	2	1	367	32	140	1	543
Hemlock	26	56	415	270	219	341	1,327
White cedar	23	25	456	107	32	24	667
Larch	....	....	53	7	1	1	62
Total Conifers	264	873	2,659	3,242	641	1,382	9,061
Sugar maple	55	253	1,094	578	177	277	2,434
Soft maple	19	42	664	278	223	229	1,455
White birch	268	5	1,136	120	153	80	1,762
Yellow birch	6	16	146	124	27	37	356
Beech	9	118	72	99	33	98	429
Elm	13	121	377	559	25	86	1,181
Ironwood	42	2	114	7	20	1	186
Red oak	165	203	1,370	659	247	465	3,109
White oak	86	111	469	184	113	113	1,076
Poplar	110	879	2,886	1,601	226	633	6,335
Black ash	4	4	231	62	22	5	328
White ash	2	14	105	68	4	10	203
Basswood	3	29	268	271	93	159	823
Black cherry	11	2	39	17	6	2	77
Total Hardwoods	793	1,799	8,971	4,627	1,369	2,195	19,754
TOTAL ALL SPECIES	1,057	2,672	11,630	7,869	2,010	3,577	28,815

the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition there is residual smaller-size material in the top which may be used as pulpwood or for purposes other than saw timber. The total quantity of wood in this residual top is relatively small, and is included in the 10 inches and over material in all inventory estimates.

The 4 to 9-inch d.b.h. class contains 48 per cent of the volume of the primary growing stock in the Lake Simcoe district, and the 10-inch and over class contains 52 per cent. Of the coniferous volume, 62 million cubic feet, or 59 per cent, is in the smaller size class and 43 million cubic feet, or 41 per cent, is in the larger size class. Hardwoods have 182 million cubic feet in the 4 to 9-inch group and 219 million cubic feet, or 55 per cent, in the 10-inch and over group (table 9). The 10-inch and over class contains 83 per cent of the mature, 38 per cent of the immature, and 66 per cent of the all-aged volume (fig. 10).

The volume on Crown lands is almost equally divided between the two size classes with 51 per cent in the 4 to 9-inch class and 49 per cent in the 10-inch and over class. The mature stands have 72 per cent and the all-aged stands 64 per cent of their volume in the larger size class, while 60 per cent of the immature volume occurs in the 4 to 9-inch class (table 10). Conifers have 61 per cent of their volume in the sawlog class, while only 44 per cent of the hardwood volume occurs in this larger size class.

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Simcoe district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	278	2,364	1,948	5,152	537	2,365	12,644
Red pine	3	....	25	19	6	17	70
White spruce	10	43	1,507	1,149	70	86	2,865
Black spruce	....	....	6	....	....	....	6
Balsam fir	110	60	6,732	963	403	73	8,341
Hemlock	1,188	4,297	4,148	5,390	1,387	2,586	18,996
White cedar	1,768	2,356	34,473	8,509	2,330	1,508	50,944
Larch	1	25	1,580	532	45	47	2,230
TOTAL CONIFERS	3,358	9,145	50,419	21,714	4,778	6,682	96,096
Sugar maple	5,723	27,126	32,499	18,358	10,444	15,946	110,096
Soft maple	837	3,612	10,857	6,687	2,383	4,373	28,749
White birch	536	490	15,865	3,763	1,084	1,192	22,930
Yellow birch	610	1,418	4,173	3,467	847	1,249	11,764
Beech	860	12,857	2,630	4,044	1,167	4,559	26,117
Elm	1,392	12,937	13,247	23,097	3,158	13,036	66,867
Ironwood	418	258	2,438	315	634	121	4,184
Red oak	179	771	4,792	2,986	585	2,122	11,435
White oak	74	188	633	276	175	214	1,560
Poplar	335	1,601	33,858	18,136	1,701	3,850	59,481
Black ash	406	415	6,065	1,239	1,156	721	10,002
White ash	224	1,535	2,636	2,419	674	1,934	9,422
Basswood	329	3,067	2,880	5,598	789	2,930	15,593
Black cherry	141	247	1,736	734	246	409	3,513
TOTAL HARDWOODS	12,064	66,522	134,309	91,119	25,043	52,656	381,713
TOTAL ALL SPECIES	15,422	75,667	184,728	112,833	29,821	59,338	477,809

The immature age class contains 68 per cent of the volume on Crown lands. White pine and poplar are the principal species in this age class, and while 69 per cent of the pine volume occurs within the sawlog size class, only 36 per cent of the poplar volume produces material of sawlog size. Of the other principal species, only elm produces predominantly sawlog material, with 60 per cent of its volume in this size class. Basswood is evenly distributed between the two size classes. The 4 to 9-inch d.b.h. group contains 61 per cent of the hemlock, 81 per cent of the white cedar, 65 per cent of the sugar maple, 70 per cent of the soft maple, 90 per cent of the white birch, 68 per cent of the red oak and 72 per cent of the white oak volume (fig. 11).

On patented lands in the Lake Simcoe district, 52 per cent of the volume occurs in the 10-inch and over d.b.h. group. This size class contains 83 per cent of the mature volume, 67 per cent of the volume in all-aged stands, but only 38 per cent of the immature volume. Conifers have nearly 59 million cubic feet, or 61 per cent of their volume, in the 4 to 9-inch group and hardwoods have 210 million cubic feet, or 55 per cent of their volume, in the 10-inch and over class (table 11).

Of the principal conifers on patented lands, white pine and hemlock produce predominantly sawlog material, while balsam fir and white cedar have most of their volume in the smaller size class. The 10-inch and over d.b.h. class contains 89 per cent of the mature white pine, 73 per cent of the immature and

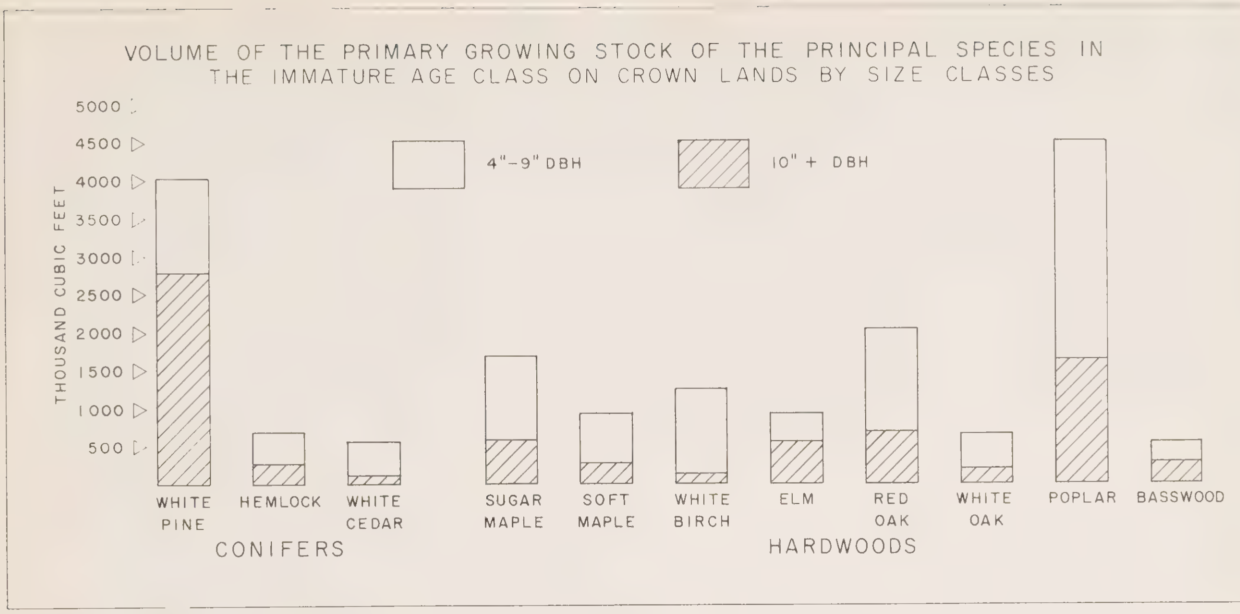


FIGURE 11

81 per cent of the all-aged volume. Hemlock has 78 per cent of the mature, 57 per cent of the immature and 65 per cent of the all-aged volume in this size class. Sixty-five per cent of the mature balsam fir volume, 87 per cent of the immature and 85 per cent of the all-aged occurs in the 4 to 9-inch d.b.h. group. Only 43 per cent of the mature white cedar occurs in the 4 to 9-inch class, but 80 per cent of the immature and 61 per cent of the all-aged volume occur in this size class (fig. 12).

Hardwoods in the mature age class on patented lands produce mainly sawlog material. Only two species, white birch and ironwood, have most of their volume in the cordwood class. The principal hardwood species, sugar maple, elm and beech, have 83, 90 and 94 per cent of their respective volumes in the 10-inch and over size class. This class also contains 81 per cent of the soft maple, 70 per cent of the yellow birch and 90 per cent of the basswood volume (fig. 13).

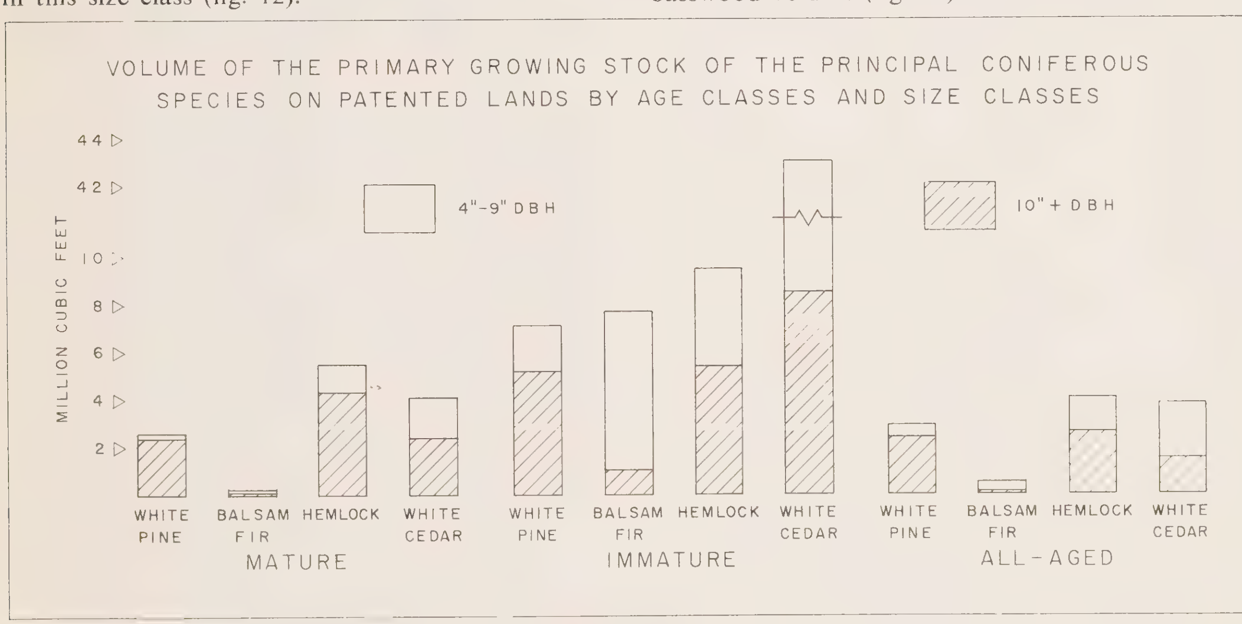


FIGURE 12

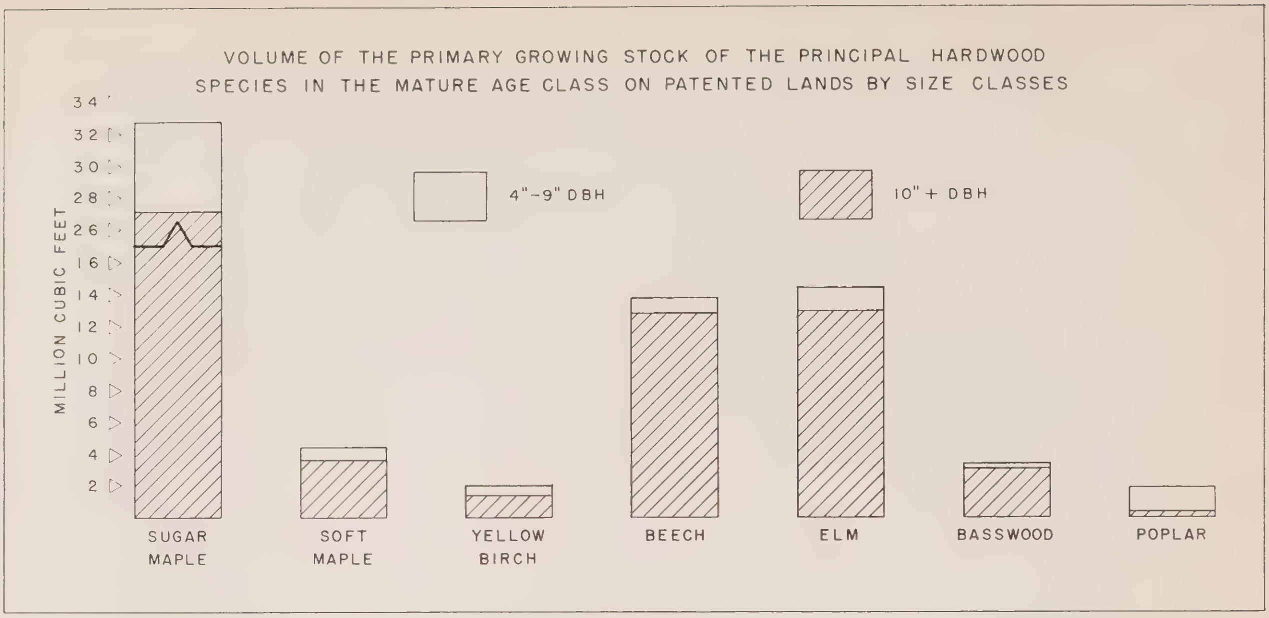


Figure 13

Five species contain 78 per cent of the immature hardwood volume on patented lands. Of these five, only elm, with 64 per cent of its volume in the 10-inch and over d.b.h. group, produces mainly sawlog material. The other four species all have the greatest percentage of their volume in the 4 to 9-inch class: hard maple 64 per cent, soft maple 62 per cent, white birch 81 per cent, and poplar 65 per cent (fig. 14). Beech and basswood are the only other species in this age class that produce mainly sawlog material.

In the all-aged stands on patented lands only black ash and ironwood have the greater part of their volume in the smaller size class. Of the principal species, beech and elm each have 80 per cent of their volume in all-aged stands in the sawlog size class, poplar has 69 per cent, soft maple 65 per cent, sugar maple 60 per cent, basswood 79 per cent and red oak 78 per cent (fig. 15).

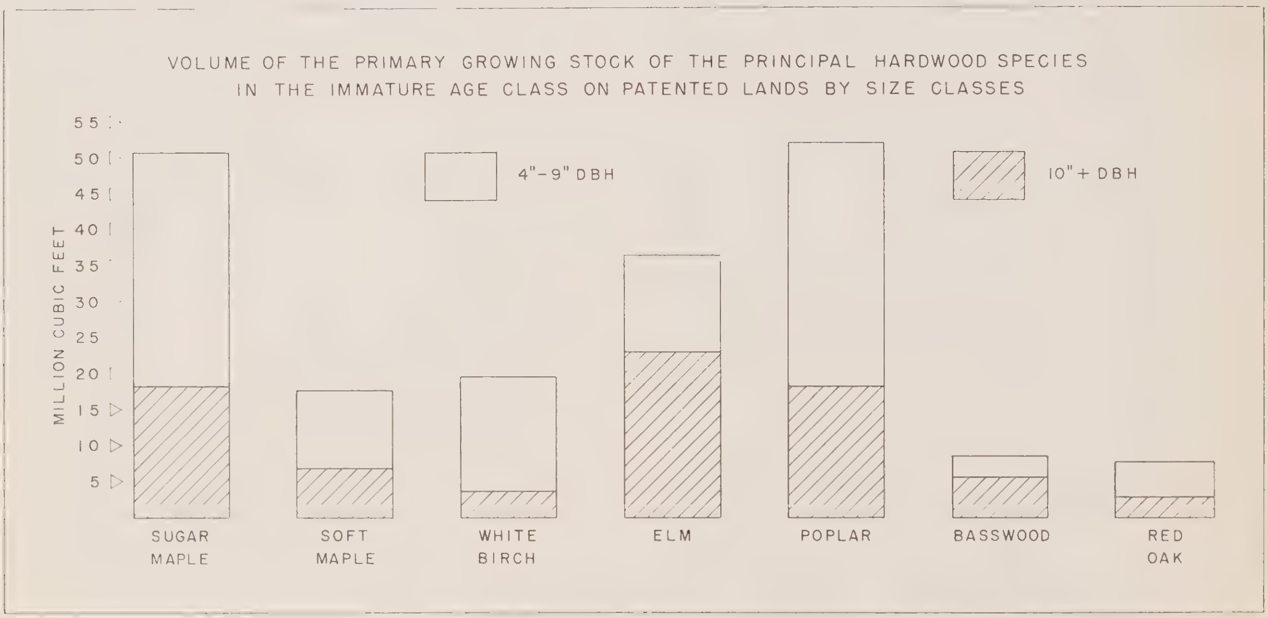


Figure 14

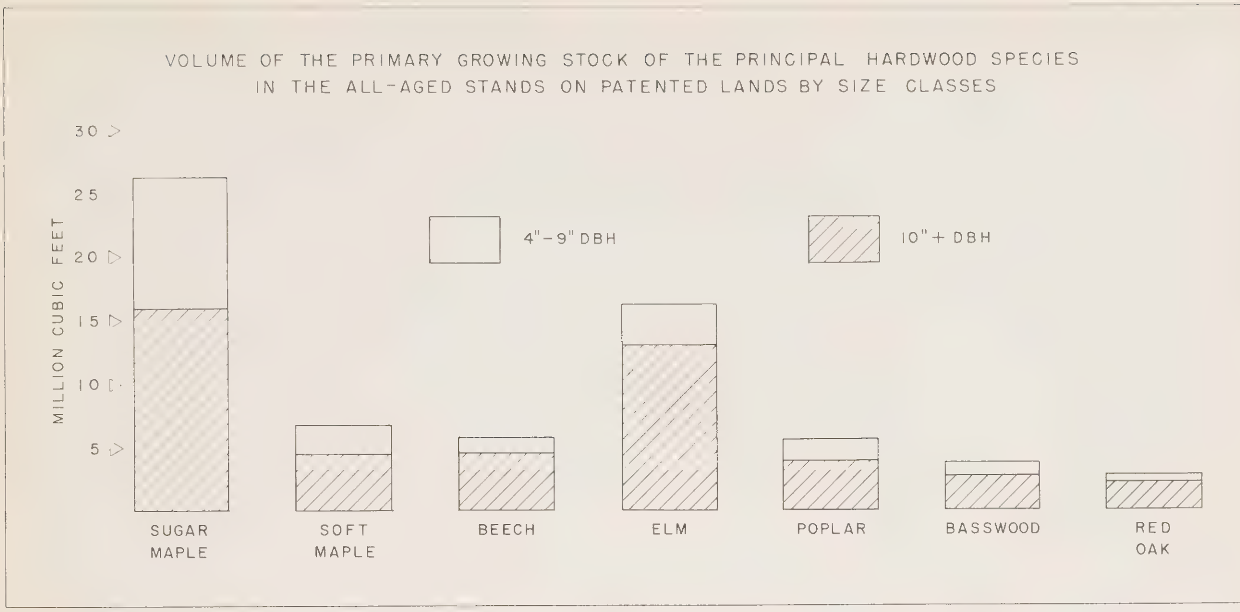


FIGURE 15

Allowable Cut

The allowable cut has been computed for each species with the aid of a volumetric formula[1] and appropriate rotation[2] for the species. Thus the amount of the allowable cut results from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

The calculation of allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. The size and structure of the primary growing stock, upon which the allowable cut calculations are based, changes from year to year, owing to woods operations and growth of the stands. Because of this, the allowable cut should be recalculated on expiration of the initial ten-year period. With effective forestry practices, allowable cuts for the valuable species will increase; without them the proportion of less desirable species in the stands will grow greater.

The annual allowable cut, or net depletion permissible under management in the Lake Simcoe district, is 12,823,640 cubic feet: 119,575 cubic feet from Crown lands and 12,704,065 cubic feet from patented lands. Of the total allowable cut, 99 per cent is on patented lands.

[1] Method of calculation of allowable cut is given in Appendix, methods, allowable cut, page 31.

[2] Rotation, by species, table 15, page 31.

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Lake Simcoe district.*

Species	Annual allowable cut *cu. ft.*
White pine	25,025
Red pine	60
White spruce	30
Balsam fir	100
Hemlock	820
White cedar	720
TOTAL CONIFERS	26,755
Sugar maple	4,620
Soft maple	2,615
White birch	10,235
Yellow birch	440
Beech	1,905
Elm	2,680
Ironwood	1,320
Red oak	5,520
White oak	1,970
Poplar	59,340
Black ash	240
White ash	480
Basswood	1,065
Black cherry	390
TOTAL HARDWOODS	92,820
TOTAL ALL SPECIES	119,575

CROWN LAND

The annual allowable cut for Crown land represents only 0.4 per cent of the primary growing stock, or 2.1 cubic feet per acre for the productive forest area. Coniferous species comprise 26,755 cubic feet, or 22 per cent, of the total allowable

cut; and hardwood species (table 12) total 92,820 cubic feet, or 78 per cent of the allowable cut.

The allowable cut for Crown lands was based on the mature areas which account for only 5 per cent of the productive forest land. The remaining areas, consisting of immature stands, young growth, and plantations, are being managed so as to increase the quantity and quality of the present growing stock, and so have not been included in the present allowable cut calculations. Thinning operations in these stands will produce a relatively small volume of timber that is not included in the allowable cut calculations.

In the present calculation of allowable cut on Crown lands three species comprise 79 per cent of the cut: poplar 50 per cent, white pine 21 per cent, and white birch 8 per cent.

PATENTED LAND

The annual allowable cut for patented lands is 12,704,065 cubic feet (table 13). This represents 2.7 per cent of the primary growing stock, or 29 9 cubic feet per acre for the productive forest land. The annual allowable cut is 1.9 per cent of the primary growing stock for conifers and 2.8 per cent for hardwoods. Coniferous species comprise 15 per cent of the allowable cut and hardwoods 85 per cent.

Four species comprise 92 per cent of the coniferous allowable cut: white cedar 51 per cent, white pine 14 per cent, balsam fir 14 per cent and hemlock 13 per cent.

Seventy-seven per cent of the hardwood allowable cut is contributed by four of the fourteen hardwood

TABLE 13. — *Annual allowable cut for all species on patented lands in the Lake Simcoe district.*

Species	Annual allowable cut *cu. ft.*
White pine	263,415
Red pine	2,185
White spruce	89,530
Black spruce	125
Balsam fir	260,655
Hemlock	237,450
White cedar	955,200
Larch	55,750
TOTAL CONIFERS	1,864,310
Sugar maple	2,064,300
Soft maple	1,347,610
White birch	716,560
Yellow birch	183,810
Beech	326,460
Elm	1,253,755
Ironwood	78,450
Red oak	214,405
White oak	19,500
Poplar	3,717,560
Black ash	187,535
White ash	176,660
Basswood	487,280
Black cherry	65,870
TOTAL HARDWOODS	10,839,755
TOTAL ALL SPECIES	12,704,065

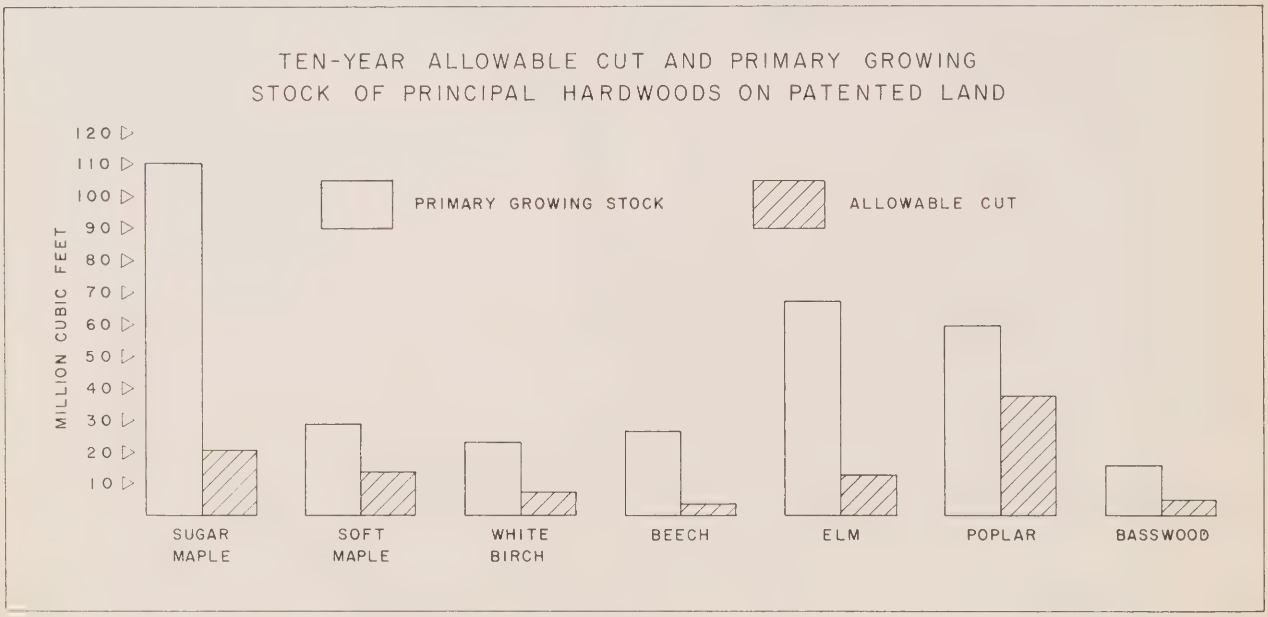


FIGURE 16

Spraying transplanted seedlings for weed control.

species. Poplar forms 34 per cent of the allowable cut, sugar maple 19 per cent, soft maple 12 per cent and elm 12 per cent. Figure 16 graphically illustrates the relationship of the allowable cut for a ten-year period to the volume of the primary growing stock for hardwoods.

Utilization vs. Allowable Cut

No statistics relating to the annual cut of timber on Crown lands in the Lake Simcoe district are collected by the Department of Lands and Forests. This district is essentially an area of privately owned land for which data pertaining to timber production is not readily available. The volume and value of products produced from farm woodlots in 1950[1] is as follows:

Fuelwood	57,651 cords
Pulpwood	173 cords
Posts	79,586 pieces
Logs	3,513,755 board feet
Poles	2,127 pieces

The above products, plus maple syrup and maple sugar, were estimated[1] to have a value of $703,748. Most of the products were utilized directly on the farm, but sufficient were sold to produce a cash income to the farmers of some $280,406. These data do not include the number or value of Christmas trees sold from private lands.

TABLE 14. — *Gross total cubic-foot volume of wood produced from patented land in one year in the Lake Simcoe district.*

Fuelwood	10,426,245
Pulpwood	25,350
Posts	2,252,435
Logs	2,489,530
Poles	60,200
TOTAL	15,253,760

By the use of appropriate converting factors, these wood volumes are expressed in gross total cubic feet (table 14). Since these volumes can not be separated by species, no detailed comparison of actual and allowable cut is possible. A comparison of the total actual cut with the total allowable cut indicates that patented lands are being overcut annually by some 2,549,695 cubic feet.

[1] Census of Canada, 1951, Volume VI, Table 27.

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs on a scale of four inches to the mile (1/15840). Following the photography, semi-controlled photo maps were prepared.

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario a photo map covers 7′30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map, the prints are mounted on a hard surface non-porous board, such as masonite, upon which control points have been plotted. The road network of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted, and makes the edges of the prints less perceptible to the eye and the camera. After a liberal application of adhesive the print is oriented on to the control and adjusted to coincide with the detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the mosaic it is photographed in two sections, producing an east and west half for each sheet. Upon production of the negative, prints are readily available.

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the mosaic. Forest data were drafted on a linen overlay, and the ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1953, 1954, 1955 and 1956, and field sampling was carried out in the summer and autumn of 1956. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood, and mixedwoods. These were separated into three age classes: mature, immature and all-aged. The volume per acre for each cover type for the mature and immature age classes was then summarized from the field tallies into three density classes. The all-aged stands were not segregated into density classes. Summaries were made separately for two ecological sections in the Lake Simcoe district. The per acre volumes in cubic feet, made up in this manner, are shown in tables 16 and 17. Table 17 was also applied to the small forested area occurring within the Niagara ecological section.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by dividing the total mature volume for each species by the respective rotation age. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 15 cubic feet per acre, and for patented lands to 23 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years and the mature age class from 30 to 300 years, depending on the species. Stands

[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department of Lands and Forests, Ontario, Parts II and III.

classed as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 15).

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotations.

The compilation was carried out in such a way that volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

(b) FORMULA

In the present calculations, the following formulae were used:

$$\text{(1) Crown land:} \quad P = \frac{\text{V.1.}}{n/3}$$

$$\text{(2) Patented land:} \quad P = \frac{5/8\ (\text{V.1.} + \text{V.2.} + \text{V.3.})}{n/3}$$

TABLE 15. — *Rotation by species.*

Species	Crown land	Patented land
	years	*years*
White pine	120	90
Red pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100

where:

V.1. — denotes volume of mature timber (Age Class I).
V.2. — denotes volume of immature timber (Age Class II).
V.3. — denotes volume of mature and immature timber in all-aged stands.
n — denotes rotation.
P — denotes annual allowable cut.

The decision to use formula (1) for Crown lands was made for the following reasons. The area of mature stands in the Lake Simcoe district is only 5 per cent of the productive forest area, which indicates a deficit of mature timber and, consequently, need of reducing the annual cut. Cutting of immature timber on Crown lands to regulate yield is not indicated inasmuch as it is the practice in Ontario to limit utilization on Crown lands to mature timber. Within this district, areas classed as Crown lands consist of County Forests under agreement and areas, largely in Baxter, Wood, Matchedash and Orillia Townships, where the soil is thin and rocky. In both cases the present aim is to build up the growing stock in the immature stands. In accordance with the foregoing, formula (1) was used in the calculation of the annual allowable cut for Crown lands, whereby only mature timber shall be cut during the initial period, on expiration of which a new mature stand will become available for utilization.

Patented lands present a different problem, requiring a separate solution, thus the choice of formula (2). These lands have a higher proportion of mature area, but the bulk of the forest land is still in the younger age classes. It is reasonable to assume that with a high population and a heavy

[1] Manual of Timber Management, Department of Lands and Forests, Ontario, Part II, page 50.

[2] L. Pardé — Traité pratique d'aménagement des forêts, Paris, 1930.

demand for wood, this demand will be met by utilizing a portion of the immature stands on patented lands. For this reason both mature and immature volumes were included in the calculations of allowable cut for patented lands with the aim of obtaining a balanced yield over a period of approximately two-thirds of the rotation.

With the aid of the above formulae, the allowable cut has been calculated for each species, separately, with full consideration of the actual growing stock of each species and the appropriate rotation. The results of individual calculations for each species have been totalled and shown as allowable cut for Crown lands and for patented lands, respectively.

Seedlings are placed in transplant beds, using Yale transplanting board.

Common and Botanical Names of Tree Species
Included in Timber Estimates

Conifers

White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Jack pine	*Pinus Banksiana Lamb.*
Scots pine	*Pinus sylvestris L.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Norway spruce	*Picea abies (L.) Karst.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Eastern larch	*Larix laricina (Du Roi) K. Koch*
European larch	*Larix decidua Mill.*

Hardwoods

Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.*
	Acer saccharinum L.
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.*
	Ulmus rubra Muhl.
	Ulmus Thomasi Sarg.
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.*
White oak	*Quercus alba L.*
	Quercus macrocarpa Michx.
	Quercus bicolor Willd.
Poplar	*Populus tremuloides Michx.*
	Populus balsamifera L.
	Populus grandidentata Michx.
	Populus deltoides Marsh.
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.*
	Fraxinus pennsylvanica Marsh.
	Var. subintegerrima (Vahl) Fern.
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Walnut	*Juglans nigra L.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch*
	Carya cordiformis (Wang) K. Koch
Sycamore	*Platanus occidentalis L.*

TABLE 16. — *Volume of the primary growing stock in cubic feet per acre.*
Algonquin Section — 1956

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	ALL-AGED
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″				37.1	31.5	20.3	
	10″ up							
Black spruce	4″–9″	....	....	....	739.9	628.2	404.1	....
	10″ up							
Larch	4″–9″	....	....	....	283.0	240.3	154.6	....
	10″ up							
TOTAL CONIFERS	4″–9″	....	....	....	1060.0	900.0	579.0	....
	10″ up	....	....	....	....	....	....	....
TOTAL HARDWOODS	4″–9″							
	10″ up	....	....	....	....	....	....	....
GRAND TOTAL	4″–9″	....	....	....	1060.0	900.0	579.0	......
	10″ up							
TOTAL 4″ UP		....	....	....	1060.0	900.0	579.0	......
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	147.4	133.3	94.0	39.1	33.6	21.6	54.2
	10″ up	446.8	404.4	285.1	67.2	57.8	37.1	139.7
Balsam fir	4″–9″				3.1	2.7	1.7	9.5
	10″ up							
Hemlock	4″–9″	....	....	....	28.9	24.9	16.0	3.5
	10″ up	....	....	....	35.2	30.2	19.4	10.3
White cedar	4″–9″	....	....	....	1.6	1.3	0.9	....
	10″ up							
TOTAL CONIFERS	4″–9″	147.4	133.3	94.0	72.7	62.5	40.2	67.2
	10″ up	446.8	404.4	285.1	102.4	88.0	56.5	150.0
Sugar maple	4″–9″	....	....	....	61.9	53.3	34.2	66.2
	10″ up	....	....	....	28.8	24.7	15.8	129.4
Soft maple	4″–9″	....	....	....	88.2	75.8	48.7	57.8
	10″ up	....	....	....	35.3	30.4	19.5	86.1
White birch	4″–9″	201.8	182.6	128.7	80.0	68.7	44.2	71.0
	10″ up	....	....	....	6.0	5.2	3.3	62.2
Yellow birch	4″–9″	....	....	....	19.5	16.8	10.8	....
	10″ up	....	....	....	18.0	15.5	9.9	....
Beech	4″–9″	....	....	....	1.6	1.3	0.9	26.2
	10″ up	....	....	....	....	....	....	40.9
Elm	4″–9″	....	....	....	20.5	17.6	11.3	....
	10″ up	....	....	....	20.1	17.3	11.1	....
Ironwood	4″–9″	25.9	23.4	16.5	12.5	10.8	6.9	3.7
	10″ up							
Red oak	4″–9″	98.4	89.0	62.8	224.7	193.3	124.1	114.9
	10″ up	38.6	34.9	24.6	103.4	88.9	57.1	264.3
White oak	4″–9″	59.0	53.4	37.7	83.5	71.8	46.1	72.5
	10″ up	66.9	60.5	42.6	30.6	26.3	16.9	37.2
Poplar (all)	4″–9″	70.6	63.9	45.0	226.3	194.7	125.0	45.2
	10″ up	688.2	622.9	439.3	208.1	179.0	114.9	224.0
Black ash	4″–9″	....	....	....	15.8	13.5	8.7	12.8
	10″ up	....	....	....	3.0	2.6	1.6	....
White ash	4″–9″	....	....	....	11.1	9.5	6.1	....
	10″ up	....	....	....	3.0	2.6	1.7	....
Basswood	4″–9″	....	....	....	45.7	39.2	25.2	80.0
	10″ up	....	....	....	40.3	34.7	22.3	161.4
Black cherry	4″–9″	7.4	6.7	4.7	....	....	....	....
	10″ up							
TOTAL HARDWOODS	4″–9″	463.1	419.0	295.4	891.3	766.3	492.2	550.3
	10″ up	793.7	718.3	506.5	496.6	427.2	274.1	1005.5
GRAND TOTAL	4″–9″	610.5	552.3	389.4	964.0	828.8	532.4	617.5
	10″ up	1240.5	1122.7	791.6	599.0	515.2	330.6	1155.5
TOTAL 4″ UP		1851.0	1675.0	1181.0	1563.0	1344.0	863.0	1773.0

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) Density Class 1	MIXEDWOODS MATURE (M-I) Density Class 2	MIXEDWOODS MATURE (M-I) Density Class 3	MIXEDWOODS IMMATURE (M-II) Density Class 1	MIXEDWOODS IMMATURE (M-II) Density Class 2	MIXEDWOODS IMMATURE (M-II) Density Class 3	MIXEDWOODS ALL-AGED
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	88.9	78.1	49.4	245.3	209.9	136.8	88.9
	10″ up	757.9	665.5	420.9	567.0	485.2	316.3	400.4
Red pine	4″–9″	8.4	7.3	4.6	7.0	6.0	3.9	3.3
	10″ up	....	....	....	5.4	4.6	3.0	10.9
White spruce	4″–9″							2.3
	10″ up							3.7
Black spruce	4″–9″	....	....	....	1.8	1.5	1.0	....
	10″ up							
Balsam fir	4″–9″	4.2	3.7	2.3	60.8	52.0	33.9	60.4
	10″ up				4.5	3.9	2.5	
Hemlock	4″–9″	46.9	41.2	26.0	56.2	48.0	31.3	96.1
	10″ up	26.3	23.1	14.6	12.7	10.9	7.1	146.6
White cedar	4″–9″	34.2	30.0	19.0	3.5	3.0	2.0	4.9
	10″ up	20.2	17.7	11.2	....	....	....	5.0
Larch	4″–9″	....	....	....	1.8	1.5	1.0	....
	10″ up							
TOTAL CONIFERS	4″–9″	182.6	160.3	101.3	376.4	321.9	209.9	255.9
	10″ up	804.4	706.3	446.7	589.6	504.6	328.9	566.6
Sugar maple	4″–9″	18.2	16.0	10.1	6.3	5.5	3.5	32.0
	10″ up	44.5	39.1	24.7	2.5	2.1	1.4	39.7
Soft maple	4″–9″	41.3	36.3	22.9	19.4	16.6	10.8	76.0
	10″ up	34.0	29.8	18.9	....	....	....	62.7
White birch	4″–9″	35.5	31.2	19.7	123.6	105.8	69.0	41.1
	10″ up	....	....	....	7.1	6.0	3.9	10.0
Yellow birch	4″–9″							9.7
	10″ up	....	....	....	....	....	....	12.7
Beech	4″–9″	4.2	3.7	2.3	....	....	....	2.4
	10″ up							17.4
Elm	4″–9″	....	....	....	4.0	3.5	2.2	2.3
	10″ up	....	....	....	4.8	4.1	2.7	....
Ironwood	4″–9″	23.0	20.2	12.8	1.8	1.5	1.0	6.3
	10″ up							
Red oak	4″–9″	150.4	132.0	83.5	95.2	81.5	53.1	70.9
	10″ up	552.2	484.9	306.6	46.1	39.4	25.7	112.7
White oak	4″–9″	40.1	35.2	22.3	32.9	28.2	18.4	25.2
	10″ up	93.7	82.3	52.0	14.8	12.6	8.2	38.5
Poplar (all)	4″–9″	66.9	58.7	37.2	306.3	262.1	170.9	83.9
	10″ up	....	....	....	110.4	94.5	61.6	199.9
Black ash	4″–9″	....	....	....	11.7	10.0	6.5	2.3
	10″ up				6.0	5.1	3.4	
White ash	4″–9″	....	....	....	....	....	....	0.2
	10″ up							
Basswood	4″–9″	....	....	....	7.1	6.0	3.9	10.8
	10″ up							4.8
Black cherry	4″–9″							2.0
	10″ up							
TOTAL HARDWOODS	4″–9″	379.6	333.3	210.8	608.3	520.7	339.3	365.1
	10″ up	724.4	636.1	402.2	191.7	163.8	106.9	498.4
GRAND TOTAL	4″–9″	562.2	493.6	312.1	984.7	842.6	549.2	621.0
	10″ up	1528.8	1342.4	848.9	781.3	668.4	435.8	1065.0
TOTAL 4″ UP		2091.0	1836.0	1161.0	1766.0	1511.0	985.0	1686.0

Table 17. — *Volume of the primary growing stock in cubic feet per acre.*
Huron Section — 1956

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	18.7	15.9	9.9	20.9	16.5	9.2	....
	10″ up	120.7	102.8	64.3	75.0	59.2	33.2	....
White spruce	4″–9″	3.0	2.5	1.6	35.0	27.6	15.5	....
	10″ up	13.2	11.3	7.0	20.1	15.9	8.9	....
Balsam fir	4″–9″	35.0	29.8	18.6	126.8	100.1	56.0	....
	10″ up	20.1	17.1	10.7	21.8	17.3	9.7	....
Hemlock	4″–9″	127.8	108.8	68.0	72.5	57.2	32.0	....
	10″ up	361.7	307.9	192.5	100.1	79.1	44.3	....
White cedar	4″–9″	682.1	580.7	362.9	1055.6	833.6	466.8	....
	10″ up	861.1	733.0	458.2	250.8	198.1	110.9	....
Larch	4″–9″	0.7	0.6	0.4	44.8	35.4	19.9	....
	10″ up	5.8	4.9	3.1	10.3	8.1	4.5	....
Total Conifers	4″–9″	867.3	738.3	461.4	1355.6	1070.4	599.4	....
	10″ up	1382.6	1177.0	735.8	478.1	377.7	211.5	....
Sugar maple	4″–9″	10.2	8.7	5.4	6.6	5.2	2.9	....
	10″ up	151.9	129.3	80.9	34.1	27.0	15.1	....
Soft maple	4″–9″	8.7	7.4	4.6	17.2	13.6	7.6	....
	10″ up	46.4	39.5	24.7	16.4	12.9	7.2	....
White birch	4″–9″	16.5	14.0	8.8	51.7	40.8	22.9	....
	10″ up	19.2	16.4	10.2	20.2	16.0	8.9	....
Yellow birch	4″–9″	35.3	30.1	18.8	30.7	24.2	13.6	....
	10″ up	120.3	102.4	64.0	29.2	23.1	12.9	....
Beech	4″–9″	4.9	4.2	2.6	0.9	0.7	0.4	....
	10″ up	131.3	111.7	69.9	11.1	8.8	4.9	....
Elm	4″–9″	15.4	13.1	8.2	34.3	27.1	15.2	....
	10″ up	221.3	188.4	117.7	97.5	77.0	43.1	....
Ironwood	4″–9″	7.1	6.1	3.8	1.1	0.9	0.5	....
	10″ up	9.1	7.7	4.8	1.3	1.0	0.6	....
Red oak	4″–9″	....	....	....	0.4	0.3	0.2	....
	10″ up	6.5	5.5	3.4	2.0	1.6	0.9	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar (all)	4″–9″	13.0	11.0	6.9	75.9	59.9	33.6	....
	10″ up	61.6	52.5	32.8	70.3	55.6	31.1	....
Black ash	4″–9″	12.0	10.2	6.4	13.5	10.6	6.0	....
	10″ up	4.2	3.6	2.2	5.7	4.5	2.5	....
White ash	4″–9″	0.9	0.8	0.5	1.2	0.9	0.5	....
	10″ up	5.6	4.7	3.0	8.4	6.7	3.7	....
Basswood	4″–9″	3.2	2.7	1.7	1.7	1.3	0.7	....
	10″ up	81.1	69.1	43.1	27.1	21.4	12.0	....
Black cherry	4″–9″	0.2	0.2	0.1	2.4	1.9	1.0	....
	10″ up	3.0	2.6	1.6	2.4	1.9	1.1	....
Total Hardwoods	4″–9″	127.4	108.5	67.8	237.6	187.4	105.1	....
	10″ up	864.7	736.2	460.0	325.7	257.5	144.0	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1593.2	1257.8	704.5	....
	10″ up	2247.3	1913.2	1195.8	803.8	635.2	355.5	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2397.0	1893.0	1060.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	0.5	0.4	0.3	2.9	2.4	1.5	2.3
	10″ up	11.1	9.5	6.0	3.7	3.2	2.0	19.0
White spruce	4″–9″	....	....	....	1.7	1.4	0.9	0.5
	10″ up	....	....	....	1.6	1.4	0.8	0.2
Balsam fir	4″–9″	....	....	....	5.9	5.0	3.1	1.6
	10″ up	....	....	....	0.7	0.6	0.4	0.3
Hemlock	4″–9″	12.5	10.6	6.7	7.7	6.5	4.1	10.2
	10″ up	48.3	41.1	26.2	12.0	10.2	6.4	26.6

TABLE 17 — *(Cont'd)*

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) *(Cont'd)* Density Class 1	2	3	HARDWOODS IMMATURE (H-II) *(Cont'd)* Density Class 1	2	3	HARDWOODS ALL-AGED *(Cont'd)*
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White cedar	4″–9″	7.1	6.0	3.8	13.6	11.5	7.2	8.8
	10″ up	7.4	6.3	4.0	2.8	2.4	1.5	4.9
Larch	4″–9″	....	....	....	1.0	0.9	0.6	0.4
	10″ up	....	....	....	0.6	0.5	0.3	0.4
TOTAL CONIFERS	4″–9″	20.1	17.0	10.8	32.8	27.7	17.4	23.8
	10″ up	66.8	56.9	36.2	21.4	18.3	11.4	51.4
Sugar maple	4″–9″	232.5	197.7	125.6	337.5	286.3	179.5	305.1
	10″ up	1073.9	913.1	580.2	181.7	154.2	96.7	438.8
Soft maple	4″–9″	29.3	24.9	15.8	86.1	73.0	45.8	55.1
	10″ up	130.0	110.6	70.3	47.0	39.9	25.0	105.1
White birch	4″–9″	8.5	7.3	4.6	72.2	61.3	38.4	13.5
	10″ up	8.9	7.5	4.8	14.9	12.6	7.9	15.1
Yellow birch	4″–9″	12.3	10.5	6.6	14.1	12.0	7.5	11.7
	10″ up	19.6	16.6	10.6	8.9	7.5	4.7	15.5
Beech	4″–9″	32.4	27.6	17.5	26.9	22.8	14.3	30.5
	10″ up	474.6	403.4	256.4	38.8	33.0	20.6	111.1
Elm	4″–9″	50.8	43.2	27.5	90.9	77.2	48.4	70.4
	10″ up	447.5	380.4	241.7	132.5	112.4	70.5	274.1
Ironwood	4″–9″	14.2	12.0	7.6	21.9	18.6	11.7	17.1
	10″ up	9.0	7.7	4.9	2.7	2.3	1.4	3.7
Red oak	4″–9″	0.8	0.7	0.4	34.7	29.5	18.5	8.3
	10″ up	16.6	14.1	9.0	22.8	19.3	12.1	44.5
White oak	4″–9″	....	....	....	0.9	0.8	0.5	0.7
	10″ up	2.9	2.5	1.6	0.7	0.6	0.4	3.1
Poplar (all)	4″–9″	6.5	5.6	3.5	210.2	178.3	111.8	30.2
	10″ up	25.4	21.5	13.7	79.0	67.0	42.0	55.0
Black ash	4″–9″	11.5	9.8	6.2	33.7	28.6	18.0	27.2
	10″ up	14.6	12.4	7.9	7.4	6.3	3.9	17.2
White ash	4″–9″	7.7	6.5	4.1	23.9	20.3	12.7	17.7
	10″ up	58.9	50.1	31.8	20.5	17.3	10.9	56.7
Basswood	4″–9″	11.7	9.9	6.3	22.2	18.8	11.8	13.9
	10″ up	98.4	83.7	53.1	37.0	31.4	19.7	58.5
Black cherry	4″–9″	4.1	3.4	2.2	13.9	11.8	7.4	6.2
	10″ up	7.5	6.4	4.1	5.8	4.9	3.1	10.8
TOTAL HARDWOODS	4″–9″	422.3	359.1	227.9	989.1	839.3	526.3	607.6
	10″ up	2387.8	2030.0	1290.1	599.7	508.7	318.9	1209.2
GRAND TOTAL	4″–9″	442.4	376.1	238.7	1021.9	867.0	543.7	631.4
	10″ up	2454.6	2086.9	1326.3	621.1	527.0	330.3	1260.6
TOTAL 4″ UP		2897.0	2463.0	1565.0	1643.0	1394.0	874.0	1892.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	11.0	9.4	5.9	5.7	4.8	3.1	18.1
	10″ up	208.5	178.2	112.7	24.8	21.2	13.6	69.7
White spruce	4″–9″	1.2	1.0	0.6	15.6	13.4	8.6	3.8
	10″ up	4.9	4.2	2.7	13.1	11.1	7.1	5.5
Balsam fir	4″–9″	11.8	10.1	6.4	75.8	64.6	41.3	18.2
	10″ up	6.5	5.5	3.5	10.4	8.9	5.7	4.8
Hemlock	4″–9″	123.5	105.5	66.8	37.8	32.2	20.6	68.1
	10″ up	458.9	392.3	248.1	48.4	41.3	26.4	112.9
White cedar	4″–9″	144.4	123.3	78.0	338.6	289.0	184.8	152.4
	10″ up	209.4	179.0	113.2	86.8	74.1	47.4	100.2
Larch	4″–9″	....	....	....	15.4	13.2	8.5	2.5
	10″ up	3.0	2.6	1.6	6.1	5.2	3.3	2.6
TOTAL CONIFERS	4″–9″	291.9	249.3	157.7	488.9	417.2	266.9	263.1
	10″ up	891.2	761.8	481.8	189.6	161.8	103.5	295.7

Table 17 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*)			MIXEDWOODS IMMATURE (M-II) (*Cont'd*)			MIXEDWOODS ALL-AGED (*Cont'd*)
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	60.2	51.4	32.5	22.6	19.3	12.3	62.4
	10″ up	375.9	321.4	203.2	20.5	17.5	11.2	155.2
Soft maple	4″–9″	23.3	19.9	12.6	40.0	34.1	21.8	34.8
	10″ up	92.6	79.1	50.0	35.4	30.2	19.4	65.8
White birch	4″–9″	17.4	14.8	9.4	137.2	117.1	74.9	36.5
	10″ up	43.6	37.3	23.6	36.9	31.5	20.2	45.4
Yellow birch	4″–9″	47.6	40.7	25.7	42.2	36.0	23.0	34.9
	10″ up	138.4	118.3	74.8	38.6	33.0	21.1	55.7
Beech	4″–9″	17.8	15.2	9.6	2.8	2.4	1.5	13.2
	10″ up	299.3	255.8	161.8	6.1	5.3	3.4	76.3
Elm	4″–9″	34.2	29.2	18.5	77.5	66.2	42.3	72.4
	10″ up	398.7	340.9	215.5	170.2	145.2	92.9	337.9
Ironwood	4″–9″	8.6	7.4	4.6	6.3	5.3	3.4	6.6
	10″ up	6.6	5.6	3.6	0.9	0.8	0.5	0.5
Red oak	4″–9″	1.6	1.4	0.9	2.1	1.8	1.1	2.8
	10″ up	25.8	22.0	13.9	3.3	2.8	1.8	11.4
White oak	4″–9″	0.1	0.1	0.1	....	....	....	....
	10″ up	2.9	2.5	1.5	....	....	....	....
Poplar (all)	4″–9″	12.6	10.8	6.8	202.3	172.6	110.5	41.9
	10″ up	42.3	36.1	22.9	151.3	129.2	82.6	110.4
Black ash	4″–9″	21.1	18.1	11.4	47.6	40.7	26.0	21.5
	10″ up	12.4	10.6	6.7	8.0	6.8	4.4	14.0
White ash	4″–9″	7.8	6.6	4.2	6.8	5.8	3.7	9.3
	10″ up	28.8	24.7	15.6	7.6	6.5	4.1	13.2
Basswood	4″–9″	9.6	8.2	5.2	10.2	8.7	5.6	16.1
	10″ up	118.4	101.2	64.0	29.3	25.0	16.0	63.7
Black cherry	4″–9″	6.9	5.8	3.7	7.7	6.6	4.2	3.8
	10″ up	11.4	9.8	6.2	3.1	2.6	1.7	5.5
Total Hardwoods	4″–9″	268.8	229.6	145.2	605.3	516.6	330.3	356.2
	10″ up	1597.1	1365.3	863.3	511.2	436.4	279.3	955.0
GRAND TOTAL	4″–9″	560.7	478.9	302.9	1094.2	933.8	597.2	619.3
	10″ up	2488.3	2127.1	1345.1	700.8	598.2	382.8	1250.7
TOTAL 4″ UP		3049.0	2606.0	1648.0	1795.0	1532.0	980.0	1870.0

Spraying system for seed beds.

Notes

Notes

Hon. C. E. Mapledoram
Minister

F. A. MacDougall
Deputy Minister

Report No. 21 of the

LAKE HURON DISTRICT

Forest Resources Inventory

— 1958 —

Division of Timber

Ontario Department of Lands and Forests

Forest Resources Inventory

—1958—

Report No. 21 of the

LAKE HURON DISTRICT

Division of Timber

Ontario Department of Lands and Forests

PREFACE

• The ability of modern technology to raise the living standard of all the people to a satisfactory and continually rising level may be limited, in the future, by the availability of raw materials. As the definitely exhaustible resources — such as minerals — become scarcer, the renewable resources — such as trees — become increasingly important to industry.

History shows, however, that until forest products become locally or nationally scarce, exploitation is commonly tolerated, and an insistent realization of the need for forestry seldom arises until the supply of renewable resources reaches a critical condition. This condition is now faced by the wood-using industries of Southern Ontario, which are, to a considerable extent, dependent upon distant sources of supply.

The restoration of local areas of depleted forest land to productivity, the building up of an adequate growing stock of timber, and the establishment of good forest management are thus matters of prime importance to this area. Secondary benefits in the control of stream flow and maintenance of water levels are increasingly important as population and industries continue to expand at a rapid rate. With the trend towards urban living, the recreational value of forested areas becomes additionally significant.

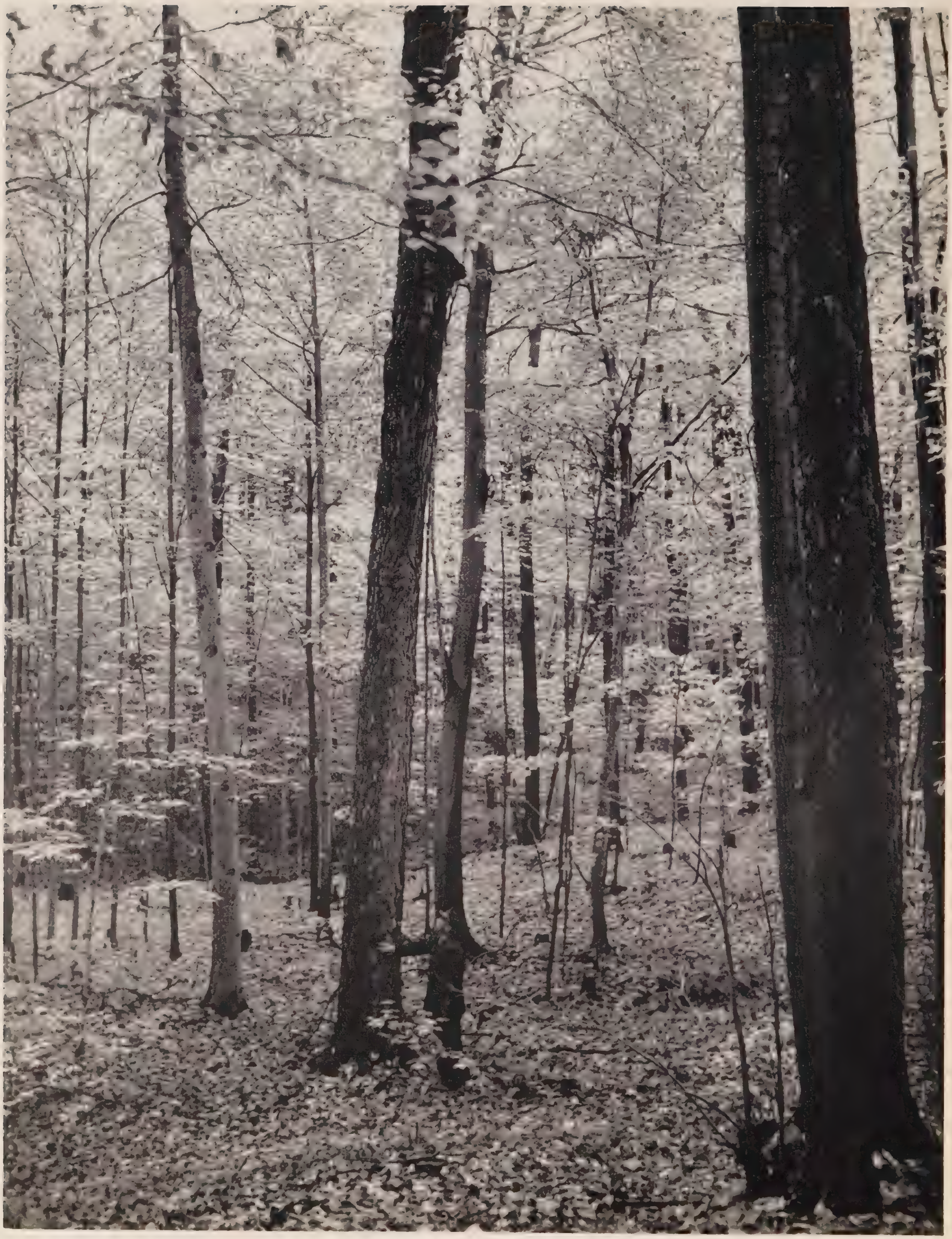
To determine the status of our forest resource, its importance in the social and economic life of the province, and the problems involved in its development, the Department of Lands and Forests has, in recent years, undertaken a province-wide survey.

The extension of the survey to include the southern agricultural areas was authorized in 1952, and work was started by the Division of Timber early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable resources, the Department of Lands and Forests has established twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the twenty-first in the series, deals with the results of the inventory in the Lake Huron district.

CONTENTS

FIGURES



SURVEY HIGHLIGHTS

1. The total area of the Lake Huron district, excluding 90,344 acres administered by the Federal Government, is 5,669,304 acres, or 8,858 square miles.

2. The total land area of the district, including those areas under Federal administration, is 5,686,018 acres. Forested areas form 17.0 per cent of this area and 77.5 per cent is devoted to agriculture. The remaining 5.5 per cent includes Federal lands, and other unclassified areas such as towns, cities, roads, railroads, power lines and gravel-pits.

3. The County Forests and Authority Forests, which are administered under an agreement with the Minister of Lands and Forests, have, for the purposes of this report, been classed as Crown land. These areas form most of the Crown lands within the district.

4. Sixty-two per cent of the productive forest has been classed as immature; 16 per cent as all-aged; 11 per cent as mature; 10 per cent as young growth; and one per cent as reproducing forest.

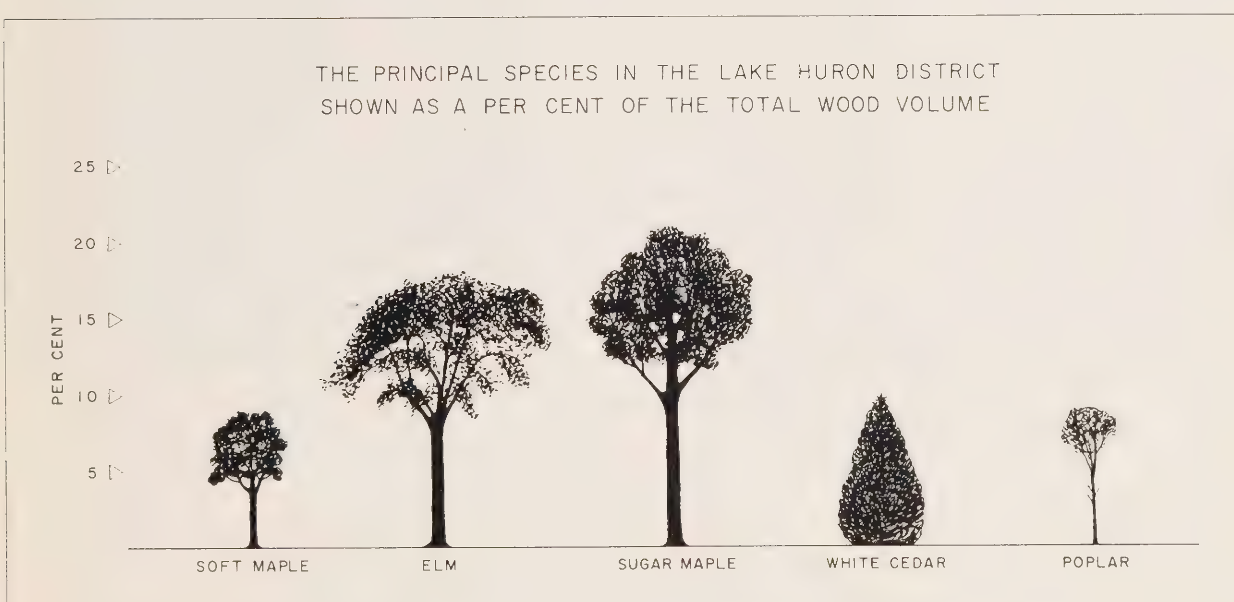
5. The hardwood cover type occurs on 64 per cent of the productive forest area; the mixedwoods type occupies 25 per cent, and the coniferous type 11 per cent.

6. The primary growing stock in the district is 1,155 million cubic feet, an average of 1,755 cubic feet per acre. Hardwood species make up 83 per cent of the total volume. Ninety-eight per cent of the growing stock occurs on patented lands.

7. The annual allowable cut, or total depletion permissible under sustained yield management in the Lake Huron district, is 29.4 million cubic feet. Hardwood species make up 88 per cent of this volume.

8. The principal species comprising the allowable cut in the district are poplar, soft maple, sugar maple, elm and white cedar.

9. From the available data, it appears that the district is being overcut annually by some 8 million cubic feet. Experience in other districts would indicate that the more valuable species are being greatly overcut, while less desirable species are not being fully utilized.



MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Town of Hespeler, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Areas

• The total area of the Lake Huron district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 5,669,304 acres (table 1), 8,858 square miles. This area is made up of 10 counties containing 104 townships. In addition, there is the Township of Tuscarora in Brant County, which is entirely Indian Reserve, and so excluded from these figures.

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	19,002	719,186	738,188
Non-forested land[2]			
Developed agricultural land	2,428	3,654,938	3,657,366
Grass and meadow land	2,536	421,694	424,230
Wooded pasture	3,804	323,728	327,532
Unclassified land[3]	216	222,908	223,124
TOTAL	8,984	4,623,268	4,632,252
Non-productive forest[4]			
Open muskeg	2,444	7,750	10,194
Treed muskeg (scrub)	40	3,646	3,686
Brush, alder and flooded land	7,744	195,882	203,626
Rock outcrop	852	6,876	7,728
TOTAL	11,080	214,154	225,234
Water	73,630	....	73,630
TOTAL AREA	112,696	5,556,608	5,669,304

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.

[2] Productive forest lands permanently withdrawn from timber production use.

[3] Lands occupied by roads, railroads, towns, etc.

[4] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity.

Within the district, inland waters, excluding the "Great Lakes," cover 73,630 acres, or one per cent of the area. Productive forest lands occupy 738,188 acres, or 13 per cent of the total area (fig. 1). Non-productive forest lands, which appear to be permanently unfit for commercial timber production, owing to very low productivity, comprise 225,234

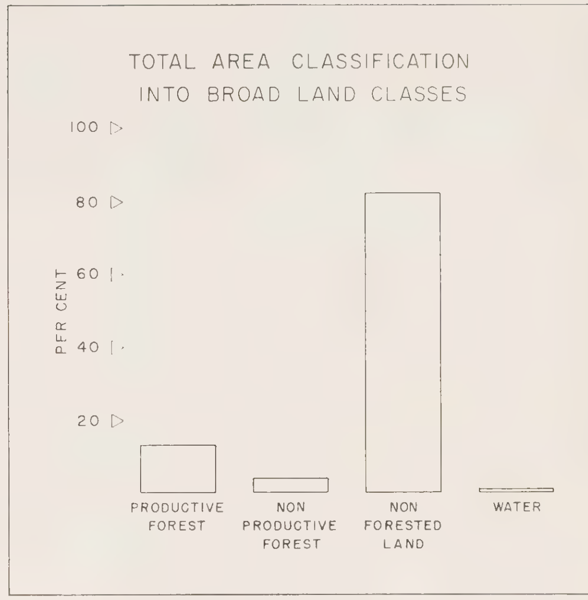


FIGURE 1

acres, or 4 per cent of the total area. Non-forested lands, which include areas permanently withdrawn from timber production, total 4,632,252 acres, or 82 per cent of the total area. Within this classification, developed agricultural lands occupy 3,657,366 acres (fig. 2), or 79 per cent of the area. Grass and

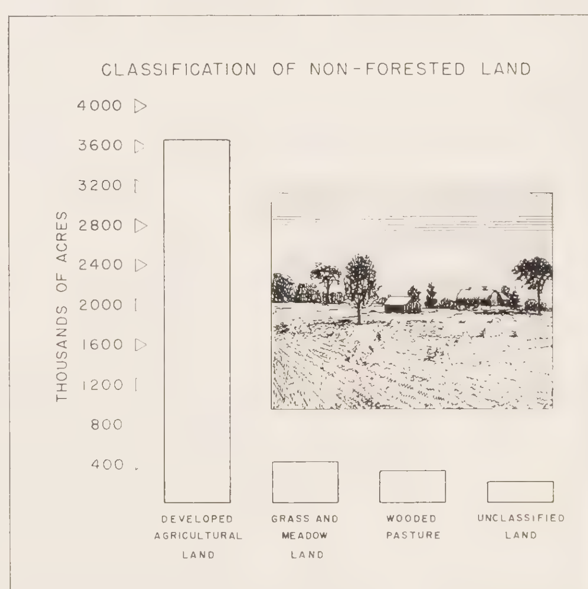


FIGURE 2

TABLE 2. — *Principal land classifications by townships and counties — Lake Huron District*

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas[1]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Brantford	77,740	76,448	2,868	3.8	616	0.8	51,122	66.9	7,528	9.8	4,008	5.2	10,306	13.5
Burford	67,660	67,096	6,764	10.1	2,798	4.2	47,648	71.0	4,212	6.3	3,640	5.4	2,034	3.0
Oakland	11,168	11,008	1,566	14.2	340	3.1	8,020	72.9	428	3.9	192	1.7	462	4.2
Onondaga	23,402	22,748	556	2.5	42	0.2	17,662	77.6	1,280	5.6	880	3.9	2,328	10.2
South Dumfries	48,448	47,582	4,104	8.6	1,178	2.5	30,282	63.7	6,680	14.0	2,726	5.7	2,612	5.5
Tuscarora	40,552	40,552	....	....	....	....	....	....	....	....	....	....	40,552	100.0
BRANT COUNTY	268,970	265,434	15,858	6.0	4,974	1.9	154,734	58.3	20,128	7.6	11,446	4.3	58,294	21.9
Albemarle	76,180	73,378	28,256	38.6	8,232	11.2	9,196	12.5	3,642	5.0	7,436	10.1	16,616	22.6
Amabel	83,352	79,440	22,784	28.7	3,274	4.1	22,476	28.3	5,128	6.5	12,788	16.1	12,990	16.3
Arran	56,930	55,170	5,384	9.8	2,130	3.9	39,582	71.7	2,880	5.2	3,934	7.1	1,260	2.3
Brant	72,226	70,794	7,794	11.0	1,792	2.6	52,042	73.5	4,900	6.9	2,046	2.9	2,220	3.1
Bruce	68,534	67,972	10,000	14.7	2,530	3.7	44,736	65.8	3,518	5.2	5,618	8.3	1,570	2.3
Carrick	61,556	60,662	7,468	12.3	2,186	3.6	45,588	75.2	2,676	4.4	1,340	2.2	1,404	2.3
Culross	58,258	57,538	9,160	15.9	2,290	4.0	40,396	70.2	2,630	4.6	1,952	3.4	1,110	1.9
Eastnor	55,692	55,284	20,676	37.4	8,888	16.1	18,040	32.6	2,440	4.4	3,856	7.0	1,384	2.5
Elderslie	56,122	55,358	3,970	7.2	1,106	2.0	41,100	74.2	3,798	6.9	3,508	6.3	1,876	3.4
Greenock	66,342	65,404	20,218	30.9	2,342	3.6	38,930	59.5	2,116	3.3	730	1.1	1,068	1.6
Huron	60,136	59,358	2,164	3.7	654	1.1	51,588	86.9	3,446	5.8	134	0.2	1,372	2.3
Kincardine	61,396	60,632	3,216	5.3	838	1.4	49,168	81.1	4,122	6.8	1,394	2.3	1,894	3.1
Kinloss	48,676	47,908	6,264	13.1	2,116	4.4	33,892	70.7	3,112	6.5	1,476	3.1	1,048	2.2
Lindsay	67,994	65,450	26,828	41.0	28,088	42.9	5,990	9.2	1,986	3.0	1,842	2.8	716	1.1
St. Edmunds	66,632	63,982	35,916	56.2	19,856	31.0	1,522	2.4	780	1.2	1,404	2.2	4,504	7.0
Saugeen	41,636	40,620	6,294	15.5	552	1.4	24,214	59.6	2,866	7.0	4,248	10.5	2,446	6.0
BRUCE COUNTY	1,001,662	978,950	216,392	22.1	86,874	8.9	518,460	53.0	50,040	5.1	53,706	5.5	53,478	15.4
Artemesia	70,400	68,262	14,748	21.6	3,660	5.4	39,802	58.3	3,618	5.3	5,154	7.5	1,280	1.9
Bentinck	77,656	76,412	13,638	17.8	3,706	4.9	45,324	59.3	4,654	6.1	6,898	9.0	2,192	2.9
Collingwood	69,752	68,986	14,706	21.3	628	0.9	33,114	48.0	6,486	9.4	11,886	17.2	2,166	3.2
Derby	42,906	42,414	6,314	14.9	1,862	4.4	22,072	52.0	3,156	7.5	6,704	15.8	2,306	5.4
Egremont	75,396	74,722	12,206	16.3	5,494	7.4	50,706	67.9	1,860	2.5	3,018	4.0	1,438	1.9
Euphrasia	74,822	73,974	14,842	20.0	1,612	2.2	40,038	54.1	7,444	10.1	8,700	11.8	1,338	1.8
Glenelg	71,090	70,248	18,294	26.0	1,764	2.5	35,062	49.9	3,870	5.5	9,806	14.0	1,452	2.1
Holland	71,612	70,422	16,404	23.3	2,516	3.6	30,276	43.0	6,616	9.4	13,168	18.7	1,442	2.0
Keppel	93,564	91,276	27,880	30.5	3,036	3.3	24,624	27.0	10,294	11.3	23,144	25.4	2,298	2.5
Normanby	70,044	69,520	8,796	12.6	3,976	5.7	50,024	72.0	2,498	3.6	3,124	4.5	1,102	1.6
Osprey	71,862	71,214	17,972	25.3	3,790	5.3	40,010	56.2	2,872	4.0	5,290	7.4	1,280	1.8
Proton	83,542	82,974	14,220	17.1	9,248	11.1	55,064	66.4	1,604	1.9	1,302	1.6	1,536	1.9
Saint Vincent	68,180	67,476	5,000	7.4	336	0.5	30,888	45.8	2,502	3.7	8,660	12.8	20,090	29.8
Sarawak	11,194	11,136	610	5.5	34	0.3	5,170	46.4	2,398	21.5	1,862	16.7	1,062	9.6
Sullivan	75,402	74,506	10,252	13.8	3,980	5.3	44,306	59.5	4,480	6.0	10,222	13.7	1,266	1.7
Sydenham	79,302	78,504	12,318	15.7	1,068	1.4	36,856	46.9	7,738	9.9	18,240	23.2	2,284	2.9
GREY COUNTY	1,106,724	1,092,046	208,200	19.0	46,710	4.3	583,336	53.4	72,090	6.6	137,178	12.6	44,532	4.1
Esquesing	70,006	69,594	13,218	19.0	1,070	1.5	41,276	59.3	6,660	9.6	3,852	5.5	3,518	5.1
Nassagaweya	45,962	45,824	13,452	29.4	1,058	2.3	22,300	48.7	2,954	6.4	5,080	11.1	980	2.1
Nelson	49,184	48,830	6,364	13.0	172	0.4	30,262	62.0	2,716	5.6	2,412	4.9	6,904	14.1
Trafalgar	71,438	70,948	4,812	6.8	188	0.3	49,350	69.5	5,874	8.3	3,428	4.8	7,296	10.3
HALTON COUNTY	236,590	235,196	37,846	16.1	2,488	1.1	143,188	60.9	18,204	7.7	14,772	6.3	18,698	7.9
Ashfield	66,600	65,682	3,888	5.9	746	1.1	53,692	81.8	4,340	6.6	1,548	2.4	1,468	2.2
Colborne	36,066	35,146	3,578	10.2	1,326	3.8	25,642	73.0	1,932	5.5	1,490	4.2	1,178	3.3
East Wawanosh	42,778	42,282	5,688	13.5	1,380	3.3	27,986	66.2	3,400	8.0	3,190	7.5	638	1.5
Goderich	58,084	57,102	6,640	11.6	2,672	4.7	35,746	62.6	7,962	13.9	1,344	2.4	2,738	4.8
Grey	65,898	65,296	5,454	8.3	4,708	7.2	41,336	63.3	10,112	15.5	2,070	3.2	1,616	2.5
Hay	55,214	54,316	4,516	8.3	1,176	2.2	39,516	72.8	5,890	10.8	1,464	2.7	1,754	3.2
Howick	70,902	70,058	8,898	12.7	3,680	5.2	48,098	68.7	4,552	6.5	3,146	4.5	1,684	2.4
Hullett	55,136	54,644	3,632	6.7	2,304	4.2	38,822	71.0	7,192	13.2	1,380	2.5	1,314	2.4
McKillop	54,630	54,068	2,502	4.6	816	1.5	42,234	78.1	6,118	11.3	1,406	2.6	992	1.9
Morris	56,334	55,788	5,362	9.6	3,046	5.5	36,512	65.4	5,864	10.5	3,604	6.5	1,400	2.5
Stanley	46,530	45,982	4,862	10.6	864	1.9	34,234	74.4	3,508	7.6	1,244	2.7	1,270	2.8
Stephen	59,300	58,412	4,334	7.4	804	1.4	40,022	68.5	8,792	15.1	1,766	3.0	2,694	4.6
Tuckersmith	42,118	41,746	2,386	5.7	936	2.2	33,598	80.5	2,304	5.5	1,146	2.8	1,376	3.3
Turnberry	37,648	36,996	5,368	14.5	1,676	4.5	24,216	65.5	2,806	7.6	1,684	4.5	1,246	3.4

TABLE 2. — (*Cont'd*)

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas[1]	
	acres	acres	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent
Usborne	43,958	43,598	1,720	4.0	264	0.6	35,974	82.5	3,386	7.8	1,278	2.9	976	2.2
West Wawanosh	43,068	42,740	7,762	18.2	2,264	5.3	28,840	67.5	1,560	3.6	1,466	3.4	848	2.0
HURON COUNTY	834,264	823,856	76,590	9.3	28,662	3.5	586,468	71.2	79,718	9.7	29,226	3.5	23,192	2.8
Blandford	31,016	30,738	2,658	8.6	1,202	3.9	19,984	65.0	3,106	10.1	1,854	6.1	1,934	6.3
Blenheim	68,368	67,440	6,556	9.7	2,012	3.0	44,940	66.6	8,136	12.1	3,924	5.8	1,872	2.8
Dereham	68,594	68,144	4,076	6.0	572	0.8	54,208	79.6	3,226	4.7	3,446	5.1	2,616	3.8
East Nissouri	49,216	48,956	2,880	5.9	1,152	2.4	35,480	72.5	6,624	13.5	2,028	4.1	792	1.6
East Oxford	36,128	35,758	1,920	5.4	478	1.3	27,540	77.0	2,668	7.5	1,246	3.5	1,906	5.3
East Zorra	61,192	60,660	2,616	4.3	730	1.2	48,802	80.5	4,636	7.6	2,358	3.9	1,518	2.5
North Norwich	36,248	35,832	2,054	5.7	114	0.3	29,626	82.7	1,592	4.5	1,216	3.4	1,230	3.4
North Oxford	23,418	23,262	830	3.6	162	0.7	16,650	71.6	2,738	11.8	1,382	5.9	1,500	6.4
South Norwich	36,778	36,362	2,212	6.1	378	1.0	28,240	77.7	1,306	3.6	3,226	8.9	1,000	2.7
West Oxford	28,126	28,002	1,410	5.0	158	0.6	21,080	75.3	2,060	7.4	1,012	3.6	2,282	8.1
West Zorra	59,730	59,254	4,110	6.9	1,748	3.0	42,098	71.0	6,690	11.3	3,132	5.3	1,476	2.5
OXFORD COUNTY	498,814	494,408	31,322	6.3	8,706	1.8	368,648	74.6	42,782	8.7	24,824	5.0	18,126	3.6
Blanshard	50,658	50,158	1,024	2.0	272	0.6	38,206	76.2	6,158	12.3	2,476	4.9	2,022	4.0
Downie	51,282	50,690	2,654	5.2	474	0.9	41,554	82.0	2,102	4.2	2,010	4.0	1,896	3.7
Ellice	56,960	56,668	3,474	6.1	1,492	2.6	46,732	82.5	3,276	5.8	656	1.2	1,038	1.8
Elma	67,626	66,954	2,578	3.8	1,458	2.2	54,198	80.9	5,262	7.9	1,712	2.6	1,746	2.6
Fullarton	42,282	41,852	2,614	6.2	660	1.6	34,184	81.7	2,196	5.2	1,288	3.1	910	2.2
Hibbert	42,254	41,862	2,512	6.0	586	1.4	33,028	78.9	3,982	9.5	1,066	2.6	688	1.6
Logan	55,860	55,724	1,544	2.8	318	0.6	50,138	90.0	2,570	4.6	534	0.9	620	1.1
Mornington	50,882	50,330	1,466	2.9	354	0.7	43,194	85.8	2,414	4.8	1,512	3.0	1,390	2.8
North Easthope	43,304	43,064	5,146	12.0	1,010	2.3	33,954	78.8	1,432	3.3	924	2.2	598	1.4
South Easthope	25,918	25,772	1,574	6.1	186	0.7	21,828	84.7	532	2.1	400	1.5	1,252	4.9
Wallace	52,238	52,132	4,516	8.7	1,918	3.7	39,138	75.1	3,888	7.4	1,346	2.6	1,326	2.5
PERTH COUNTY	539,264	535,206	29,102	5.5	8,728	1.6	436,154	81.5	33,812	6.3	13,924	2.6	13,486	2.5
North Dumfries	48,144	47,656	5,058	10.6	1,680	3.5	28,080	58.9	7,026	14.8	1,136	2.4	4,676	9.8
Waterloo	92,770	91,590	8,962	9.8	1,558	1.7	58,088	63.4	7,632	8.3	1,598	1.8	13,752	15.0
Wellesley	66,910	66,218	4,584	6.9	544	0.8	55,138	83.3	2,062	3.1	2,330	3.5	1,560	2.4
Wilmot	64,572	63,752	5,964	9.4	728	1.1	50,064	78.5	3,698	5.8	1,586	2.5	1,712	2.7
Woolwich	56,008	55,518	5,434	9.8	504	0.9	44,134	79.5	1,978	3.6	2,310	4.1	1,158	2.1
WATERLOO COUNTY	328,404	324,734	30,002	9.2	5,014	1.6	235,504	72.5	22,396	6.9	8,960	2.8	22,858	7.0
Arthur	67,870	67,266	4,138	6.1	3,008	4.5	52,896	78.6	2,538	3.8	3,290	4.9	1,396	2.1
Eramosa	45,404	45,236	7,628	16.9	1,142	2.5	30,430	67.3	3,316	7.3	2,030	4.5	690	1.5
Erin	73,166	72,952	14,792	20.3	2,178	3.0	36,724	50.3	15,424	21.1	2,528	3.5	1,306	1.8
Guelph	42,358	42,056	3,074	7.3	1,374	3.3	26,352	62.6	2,906	6.9	1,340	3.2	7,010	16.7
Maryborough	56,940	56,552	3,456	6.1	1,630	2.9	46,394	82.0	1,994	3.5	1,970	3.5	1,108	2.0
Minto	73,132	72,514	8,992	12.4	3,962	5.5	51,078	70.4	3,730	5.2	3,210	4.4	1,542	2.1
Nichol	29,664	29,530	2,232	7.6	710	2.4	22,190	75.1	2,082	7.1	884	3.0	1,432	4.8
Peel	75,276	74,614	3,290	4.4	1,540	2.1	60,576	81.2	5,224	7.0	2,612	3.5	1,372	1.8
Pilkington	30,768	30,582	1,980	6.5	904	3.0	23,666	77.4	2,290	7.5	1,362	4.4	380	1.2
Puslinch	61,850	61,242	11,044	18.0	2,816	4.6	31,080	50.8	13,148	21.5	1,794	2.9	1,360	2.2
West Garafraxa	48,718	46,790	3,948	8.4	810	1.7	33,778	72.2	5,508	11.8	1,858	4.0	888	1.9
West Luther	51,164	50,822	5,034	9.9	6,794	13.4	36,226	71.3	1,240	2.4	792	1.6	736	1.4
WELLINGTON COUNTY	656,310	650,156	69,608	10.7	26,868	4.1	451,390	69.4	59,400	9.1	23,670	3.7	19,220	3.0
Ancaster	46,932	46,504	2,742	5.9	482	1.1	30,108	64.7	5,496	11.8	2,046	4.4	5,630	12.1
Barton	18,860	18,740	76	0.4	24	0.1	2,794	14.9	96	0.5	92	0.5	15,658	83.6
Beverly	72,498	71,854	9,324	13.0	2,736	3.8	43,502	60.5	11,346	15.8	3,046	4.2	1,900	2.7
Binbrook	27,236	26,948	1,360	5.1	226	0.8	22,592	83.8	1,208	4.5	782	2.9	780	2.9
East Flamborough	34,848	34,692	4,148	12.0	1,330	3.8	20,122	58.0	2,438	7.0	2,196	6.3	4,458	12.9
Glanford	24,020	23,842	506	2.1	168	0.7	20,330	85.3	664	2.8	334	1.4	1,840	7.7
Saltfleet	30,916	30,702	1,414	4.6	22	0.1	22,414	73.0	114	0.4	232	0.7	6,506	21.2
West Flamborough	33,336	32,750	3,698	11.3	1,222	3.7	17,622	53.8	4,298	13.1	1,098	3.4	4,812	14.7
WENTWORTH COUNTY	288,646	286,032	23,268	8.1	6,210	2.2	179,484	62.8	25,660	9.0	9,826	3.4	41,584	14.5
TOTAL – L. HURON DISTRICT	5,759,648[2]	5,686,018[2]	738,188	13.0	225,234	4.0	3,657,366	64.3	424,230	7.4	327,532	5.8	313,468[2]	5.5

[1] Other areas include all land administered by the Federal Government, and roads, railways, villages, towns, cities, gravel-pits, etc.

[2] These totals include land areas administered by the Federal Government.

meadow land occupy 424,230 acres, and 327,532 acres are classed as wooded pasture. These are low-density stands composed of a few large open-grown trees with wide-spreading crowns. In addition, there are 223,124 acres of unclassified land occupied by cities, towns, villages, roads, railways, power lines, gravel-pits or otherwise withdrawn from forest production.

An analysis of the principal land classifications by townships and counties shows that 58 per cent of the productive forest area in the district occurs in the counties of Bruce and Grey. Productive forest land comprises 22.1 per cent of the total land area in Bruce County and 19.0 per cent of Grey County (table 2). This classification forms only 5.5 per cent of Perth County and 6.0 per cent of Brant County. Productive forest land varies from a low of 0.4 per cent in Barton Township to a high of 56.2 per cent in St. Edmunds Township (fig. 3).

FIGURE 3

Non-productive forest lands occupy a relatively small proportion of the land area in the district. They occur most frequently in Bruce, Grey, Wellington and Huron counties. In Bruce County they comprise 42.9 per cent of Lindsay Township and 31.0 per cent of St. Edmunds. Within these two townships, non-productive forest lands total 47,944 acres.

Agricultural land, which comprises developed agricultural land, grass and meadow, and wooded pasture, forms 90.4 per cent of Perth County and 88.3 per cent of Oxford County. This category forms over 60 per cent of all counties, reaching its lowest point in Bruce County, where it makes up 63.6 per cent of the land area. Developed agricultural land (land under cultivation) ranges from a low of 2.4 per cent in St. Edmunds Township to a high of 90.0 per cent in Logan Township.

Forest Land Ownership

Land settlement, from the earliest days, has been accompanied by various regulations under which certain tree species, principally oak and pine, were reserved to the Crown. Pine trees were reserved on land located as free grants by The Act of 1868, but they were returned to the grantee with the land when patent was issued. After 1880, however, the usual practice in Ontario was to reserve pine timber to the Crown when the patent was issued.

This condition existed until 1937, except that in 1913 an amendment to The Public Lands Act provided that where land was not in timber licence and the locatee was in residence with improvements, he could request that pine trees be included in the patent, or in the event that patent had previously been issued, he could request a pine patent.

The Public Lands Amendment Act, 1946, granted to the patentee all species of timber on land disposed of for agricultural purposes and patented prior to May 1, 1880. Subsequently, all pine reservations were removed from lands patented for agricultural purposes, regardless of the date of patent (Stat. 1951, chap. 71).

The Forestry Act (Stat. 1952, chap. 32) permits the Minister of Lands and Forests to enter into an agreement with the owners of lands that are suitable for forestry purposes for the reforestation and management of such lands for a stated period of years, which must not be less than 20 years.

Under the terms of The Trees Act (R.S.O. 1950, chap. 399), municipalities may purchase land and either place the responsibility of reforestation and management in the hands of the Province through co-operative agreements, or carry out the planting and management of the forests without an agreement. The agreement provides that the Province will assume the responsibility for re-establishment and care of the forest for a stated period of years, usually fifty in recent agreements. At the end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price.

The Conservation Authorities Act (R.S.O. 1950, chap. 62) permits the authority to enter into an agreement with the Minister of Lands and Forests for the administration of Authority Forests. These agreements are similar, although not identical, to those entered into by the municipalities and the Crown.

Classified as Crown lands within this district are 40,083 acres administered by the Minister of Lands and Forests under the authority of The Forestry Act. County Forests account for 26,501 acres of this area and Conservation Authorities for 13,582 acres.

The area of County Forests is made up of forests in the following counties: Brant 50 acres, Bruce 14,656 acres, Grey 6,668 acres, Halton 1,546 acres, Huron 1,339 acres, Oxford 733 acres, Waterloo 710 acres and Wentworth 799 acres.

The acreages by Conservation Authorities are as follows: Big Creek 282 acres, Otter Creek 287 acres, Grand 1,408 acres, Saugeen 6,089 acres, North Grey, 875 acres, Ausable 1,406 acres, Middle Maitland 350 acres and Upper Thames 2,885 acres.

Age Classes

The forested areas of Southern Ontario have been segregated into five age classifications for inventory purposes. Mature forest, which includes overmature stands, are stands at or over their rotation age; immature forests from one-third rotation age to rotation age but over 3.5 inches d.b.h. All-aged stands contain trees of all age classes occurring together in various proportions. Areas of regeneration, below one-third rotation age or under 3.5 inches d.b.h., have been classed as young growth when the cover type can be determined, and as reproducing forest when they have been too recently established to determine the cover type.

The total productive forest area of the Lake Huron district is classed as 11 per cent mature, 62 per cent immature, 16 per cent all-aged, 10 per cent young growth, and one per cent reproducing forest (table 3, fig. 4).

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	....	1,464	1,464	*
Hardwood	214	77,954	78,168	10
Mixedwoods	70	5,650	5,720	1
TOTAL	284	85,068	85,352	11
Immature forest:				
Coniferous	3,616	64,306	67,922	9
Hardwood	5,076	250,962	256,038	35
Mixedwoods	3,562	128,218	131,780	18
TOTAL	12,254	443,486	455,740	62
All-aged forest:				
Hardwood	1,156	97,464	98,620	13
Mixedwoods	88	18,668	18,756	3
TOTAL	1,244	116,132	117,376	16
Young growth:				
Coniferous	142	4,994	5,136	1
Hardwood	2,390	38,794	41,184	6
Mixedwoods	332	24,064	24,396	3
TOTAL	2,864	67,852	70,716	10
Reproducing forest	2,356	6,648	9,004	1
TOTAL PRODUCTIVE FOREST	19,002	719,186	738,188	100

* Less than one per cent.

Patented lands, which comprise 97 per cent of the productive forest area in the district, have a very similar age class distribution to that shown for the total productive forest area.

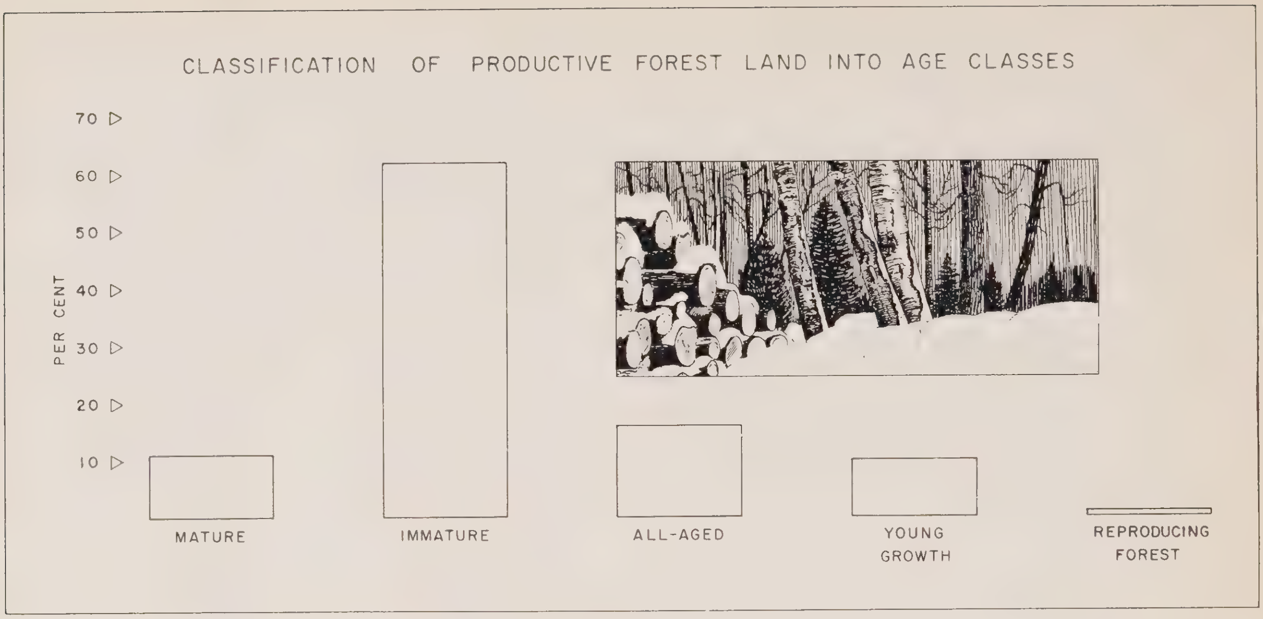


Figure 4

Crown lands, totalling 19,002 acres, form only 3 per cent of the productive forest area. The mature age class occupies only one per cent of the productive forest area; the immature, 65 per cent; the all-aged stands, 7 per cent; young growth, 15 per cent; and reproducing forest, 12 per cent.

Regional Forest Types

Most of the Lake Huron district lies within the Great Lakes–St. Lawrence Forest Region, with the southernmost portions in the Deciduous Forest Region. Sugar maple, beech, and yellow birch are the indicating species for the Great Lakes–St. Lawrence region. The Deciduous Region contains such species as tulip tree, magnolia, mockernut hickory, chestnut oak and black walnut.

Separate volume and yield tables are prepared for each region, or section, and they serve as units in the compilation of volume estimates. In the Lake Huron district two forest sections are represented (fig. 5), as follows:

1. The Huron section covers most of the district, or 84 per cent of the area.

2. The Niagara section occupies the southeast part of the district and also includes Stephen Township in the southwest. It represents 16 per cent of the district.

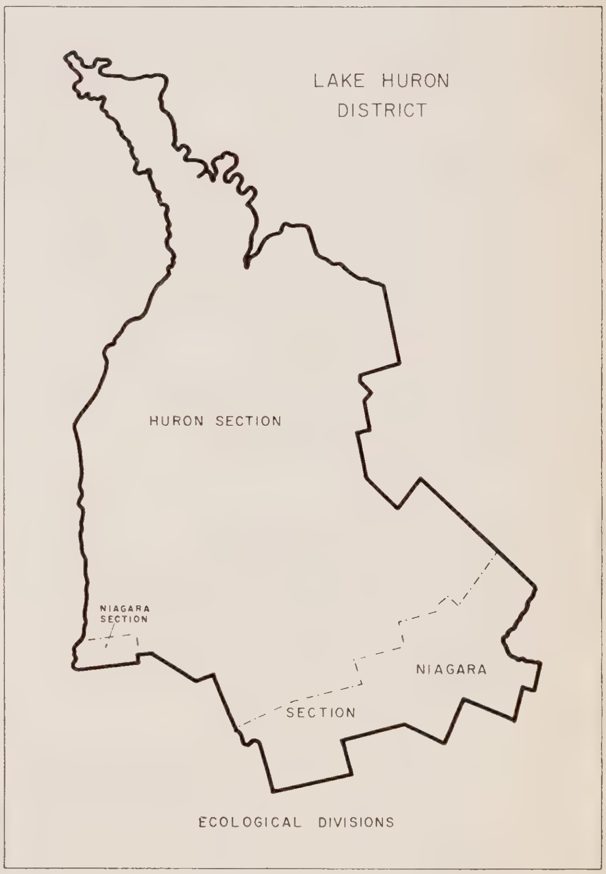


Figure 5

The Huron section is underlain by the Ordovician and Silurian rocks of the Palaeozoic Era. The limestone, sandstone, shale and dolomite are overlain by glacial material which may, in turn, be modified by wave action and lacustrine deposits. A broadleaved forest is prevalent, and sugar maple and beech are the principal species. Elm and soft maple are very common, and many other deciduous species occur as scattered groups or individuals throughout the region.

The Niagara section occupies the most southerly latitude in Canada. The favourable climatic and soil conditions permit the sole distribution in Canada of many Deciduous Forest species. Most of the associations are composed of broadleaved trees, many of small size. Within this section occurs the main Canadian distribution of black walnut, sycamore, swamp white oak and shagbark hickory. In addition, it represents the northern limit for chestnut, tulip tree, mockernut and pignut hickories, chinquapin, chestnut, scarlet, black and pin oaks, black gum, blue ash, magnolia, papaw, Kentucky coffee tree, redbud, red mulberry and sassafras. Most of these species appear as scattered individuals, or groups, often on specialized sites. The more widely distributed butternut, bitternut hickory, rock elm, silver maple and blue beech are also present. Conifers are poorly represented except for plantations. The flat-lying Devonian limestones and shales are deeply covered by glacial material. The fertile soils accompanied by a favourable climate have resulted in heavy settlement accompanied by a great reduction in the original forest cover.

The forested areas are largely restricted to the sites and land forms not suited to agricultural production. Within the district the following local land forms, or minor physiographic regions[1] (fig. 6), have been recognized:

1. *Bruce Peninsula.* — This is an area of irregular limestone, with only a little scattered overburden. The rock strata dip to the west; thus the Lake Huron shore is low with boulders, gravel, sandbars and intervening strips of wet land, while the Georgian Bay shore has high bluffs, some over 200 feet high. Scattered farms occur on shallow soils, beef cattle being the principal crop.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951.

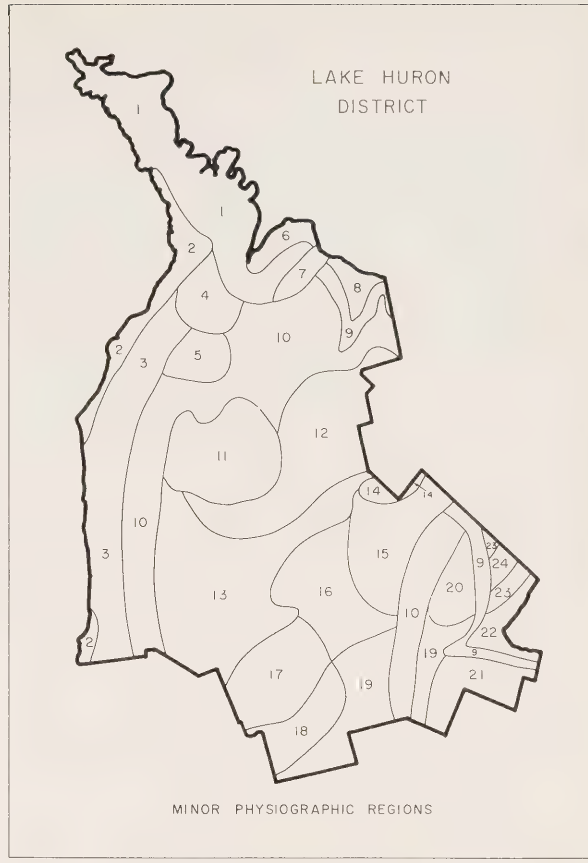


Figure 6

2. *Huron Fringe.* — A narrow strip of wave-cut terraces, with boulders, gravel bars and sand dunes, extends 200 miles along Lake Huron from Sarnia to Tobermory.

3. *Huron Slope.* — The land, rising from 600 to 900 feet above sea-level, is a clay plain modified by a narrow strip of sand and the twin beaches of glacial Lake Warren. A brown calcareous clay till rests on stratified clay. The sandy strip consists of shallow sand spread over clay, and it has a high water table. Grazing is a feature of this region.

4. *Arran Drumlin Field.* — This covers about 200 square miles and contains several hundred long, narrow drumlins. The till is a highly calcareous, heavy loam containing many stones and boulders. Interdrumlin depressions are often occupied by swamps or small lakes. Soil is good for general farming.

5. *Saugeen Clay Plain.* — A small clay plain, underlain by deep stratified clay, it has been deeply cut by rivers and streams crossing it and further disrupted by lateral gullying.

6. *Cape Rich Steps.* — This small area of 50 square miles rises 500 feet in a series of five steps to 1,100 feet above sea-level. Red clay soil comprises the greater part of the area, although the terraces each differ somewhat in character.

7. *Bighead Valley.* — This valley is an indentation of the Niagara escarpment, and is about 8 miles wide and 10 to 12 miles deep. It is completely covered with drumlins, oriented in a north-south direction and composed of greyish-brown calcareous till with an admixture of red shale. This soil is both productive and adaptable, and while the main agriculture is the production of beef and pork some farms specialize in apple growing.

8. *Beaver Valley.* — This valley of 77 square miles is a sharply cut indentation in the Niagara cuesta, with the flat valley floor about 650 feet below the rim. This small area contains a great variety of land forms, including lake plains, beaches, moraines, steep valley sides and vertical cliffs. Most of the valley carries on generalized agriculture, but a section of the lake plain, with well-drained loamy soils and a favourable climate due to the sheltering hills and proximity to Georgian Bay, is devoted to apple orchards.

Cedar posts cut from County Forest land.

9. *Niagara Escarpment.* — From Ancaster to Queenston, the escarpment is a simple topographic break separating the two levels of the Niagara peninsula. This is broken by the Dundas valley, which determines the location of the chief road and rail routes from Lake Ontario to southwestern Ontario. Northward, the escarpment increases from 800 to 1,450 feet above sea-level in 50 miles. In this section, a broad belt of red shale is exposed, and the long lower slopes are badly eroded. Where the escarpment re-enters the district west of Collingwood, the steepest and most mountainous section occurs. West of this, the ridge retreats southward in the great re-entrant of the Beaver valley, and then again turns north, ending about four miles from the shore of Georgian Bay.

10. *Horseshoe Moraines.* — An extensive portion of these moraines occurs in this district. The toe of the horseshoe lies south of Collingwood at 1,700 feet above sea-level. In general, the area is formed by irregular, stony knobs and ridges and gravel or swamp-floored valleys. The western arm consists of knobby clay ridges flanked by a broad spillway. The northern and eastern arms are more hilly and stony, and the soil contains more gravel and sand. Throughout the region, the land is chiefly used for livestock production.

11. *Teeswater Drumlin Field.* — This area, of 575 square miles, contains drumlins that are characteristically low, broad, oval hills with gentle slopes. The region is traversed by broad valleys containing sand and gravel terraces which fill the low ground between the drumlins. It is one of the good general farming areas of Southern Ontario.

12. *Dundalk Till Plain.* — Swamps, bogs and poorly drained depressions are characteristic of this gently undulating plain. The pebbly loam is overlain by a superficial silt deposit. This region has the coolest and shortest growing season of any farming area in Southern Ontario.

13. *Stratford Till Plain.* — This broad clay plain is an area of ground moraine interrupted by several terminal moraines. It slopes towards the southwest and has a faint knoll and sag relief. The till of brown calcareous silty clay is fairly uniform throughout this area. Lying on the slope east of Lake Huron in the snow-belt, it receives more rain and snow than

is usual in Southern Ontario. The farm economy is based on beef cattle and hogs, while in certain sections dairying is important.

14. *Hillsburg Sand Hills.* — The characteristic feature is rough topography with flat-bottomed, swampy valleys. Fine sands are prevalent, and the soils on the steeper slopes are droughty and erosive.

15. *Guelph Drumlin Field.* — The drumlins are broad and oval with moderate slopes. The general land pattern consists of drumlins, or groups of drumlins, fringed by gravel terraces and separated by swampy valleys. The loam is fertile, easily worked, adaptable to many crops and durable if erosion is controlled.

16. *Waterloo Hills.* — This is an area of sandy hills, ridges of sandy till and kames, with outwash sand occupying the intervening hollows. A characteristic feature is the preponderance of fine sand. Soils are well drained, and under cultivation the short, steep slopes have suffered serious erosion.

17. *Oxford Till Plain.* — This upland area, with an undulating landscape, is crossed by three well-marked valleys. The brown calcareous till, because of gentle slopes, good drainage, loamy texture, neutral reaction and lack of extreme stoniness, is a good soil.

18. *Mount Elgin Ridges.* — The morainic ridges are composed of well-drained pale brown calcareous clay loams. The crests are about 100 feet above the valleys, where poor drainage prevails. The alluvial soils in the hollows are gravel, sand and silt loams.

19. *Norfolk Sand Plain.* — The northern portion of this plain occurs in the Lake Huron district. Deep sandbeds overlie strata of silt, clay or boulder clay. The intermorainal sections in the north have large tracts of bog or wet sands. The sandy, infertile soils have been utilized for tobacco production.

20. *Flamborough Plain.* — This limestone plain slopes to the south and contains numerous swamps. A few scattered drumlins occur, but except for these the scattered overburden is either bouldery glacial till or sand and gravel.

21. *Haldimand Clay Plain.* — The northern part of this plain occurs in the Lake Huron district. Here the plain has more relief than further south, and there is a confused intermixture of clay and till.

22. *Iroquois Plain.* — West of Grimsby, the soil is heavy in texture and of low permeability and is largely devoted to orchards and vineyards. Between Stony Creek and Hamilton, there are broad gravel ridges with well-drained gravelly loams. The narrow lakeshore area between Hamilton and Toronto is a sloping well-drained sand plain. For many years this was an important horticultural area, but in recent years it has undergone rapid urbanization.

23. *South Slope.* — The western section, split by the Peel Plain, has acid clay loams on shaly tills. This western part of the region is less productive and harder to till than areas east of Toronto.

24. *Peel Plain.* — A heavy-textured clay soil occupies this level to undulating tract. Evaporation from the clay is high, and the underlying shales are not good aquifers. Thus the water supply is a problem in this area.

Cover Types

Twenty-five native species, or species groups, occur within the forests of the Lake Huron district in sufficient volume to be incorporated into this report. In addition, there is a scattered representation of many of the species associated with the Deciduous Forest Region, as well as those species, primarily coniferous, which have been introduced in plantations within the district.

The forests of the district are described under three main cover types: coniferous, hardwood, and mixedwoods. The coniferous type is one in which 75 per cent or more of the number of trees are conifer or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there are small areas of recently established natural reproduction that have not yet attained a sufficiently stable composition to be classified into cover types. The artificially established plantations are areas of reproduction which have been classified according to cover type.

The hardwood type occupies 64 per cent of the productive forest land (table 4, fig. 7); the mixedwoods type covers 25 per cent; and the coniferous type 11 per cent.

TABLE 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	....	....	1,464	*	1,464	*
Immature	3,616	19	64,306	9	67,922	9
Young growth	142	1	4,994	1	5,136	1
Plantations	2,152	11	4,012	*	6,164	1
TOTAL	5,910	31	74,776	10	80,686	11
Hardwood type:						
Mature	214	1	77,954	11	78,168	11
Immature	5,076	27	250,962	35	256,038	35
All-aged	1,156	6	97,464	14	98,620	13
Young growth	2,390	13	38,794	5	41,184	5
Plantations	....	....	104	*	104	*
TOTAL	8,836	47	465,278	65	474,114	64
Mixedwoods type:						
Mature	70	*	5,650	1	5,720	1
Immature	3,562	19	128,218	18	131,780	18
All-aged	88	*	18,668	3	18,756	3
Young growth	332	2	24,064	3	24,396	3
Plantations	....	....	....	....	....	....
TOTAL	4,052	21	176,600	25	180,652	25
Reproducing forest	204	1	2,532	*	2,736	*
TOTAL PRODUCTIVE FOREST	19,002	100	719,186	100	738,188	100

* Less than one per cent.

Patented lands, which contain the largest areas of forested land in the district, have a very similar distribution of cover types with the hardwood type occupying 65 per cent of the area, the mixedwoods type 25 per cent and the coniferous type only 10 per cent.

The cover type distribution on Crown land differs considerably with the hardwood type on 47 per cent of the area, the mixedwoods type on 21 per cent, and the coniferous type on 31 per cent.

Plantations form 36 per cent of the 5,910 acres classified under the coniferous cover type on Crown lands. There are 4,012 acres of coniferous plantations on patented lands, but this represents only 5 per cent of the coniferous cover type. Many of the private plantations consist primarily of Scots pine grown for Christmas trees.

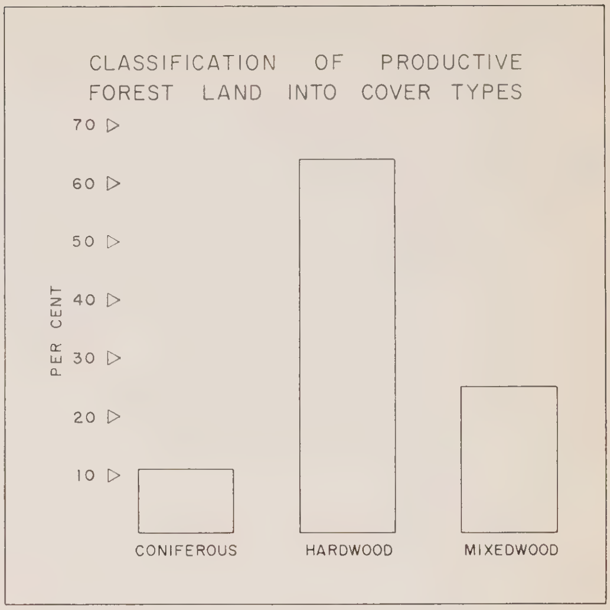


FIGURE 7

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull or defective portions of living trees, but excludes all limb wood.

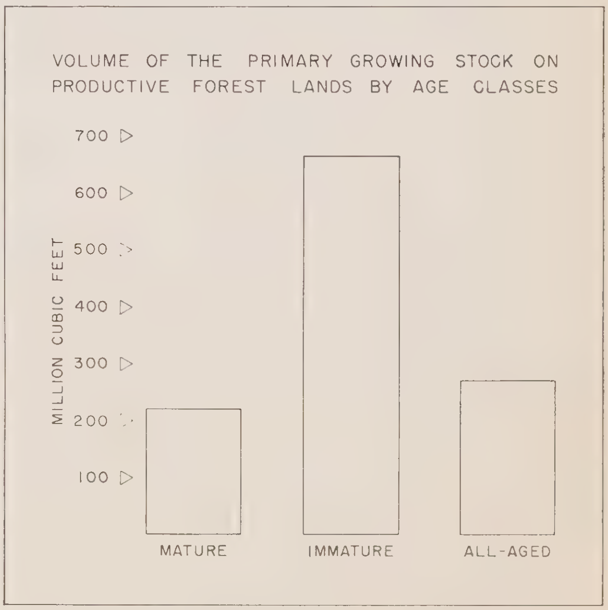


FIGURE 8

The volume of the primary growing stock on productive forest lands in the Lake Huron district is just over one billion cubic feet (1,155,318,000 cubic feet). This is an average of 1,755 cubic feet per acre (table 5). The mature age class contains 219.4 million cubic feet (table 6), or 2,571 cubic feet per acre; the immature age class contains 665.2 million cubic feet, or 1,460 cubic feet per acre; and the all-aged stands contain 270.7 million cubic feet (fig. 8), or 2,306 cubic feet per acre.

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average total
	4″–9″ d.b.h.	10″ up d.b.h.	Average total	4″–9″ d.b.h.	10″ up d.b.h.	Average total	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	445	2,148	2,593	432	2,138	2,570	2,571
Immature	870	515	1,385	897	565	1,462	1,460
All-aged	752	1,468	2,220	775	1,532	2,307	2,306
Productive forest	851	634	1,485	814	947	1,761	1,755

Crown lands within the district support a total volume just over 20 million cubic feet (table 7), or an average of 1,485 cubic feet per acre. The mature age class contains 0.7 million cubic feet, or 2,593 cubic feet per acre; the immature age class contains 17.0 million cubic feet, or 1,385 cubic feet per acre; and the all-aged stands contain 2.8 million cubic feet, or 2,220 cubic feet per acre.

Patented lands within the district have a primary growing stock of 1.1 billion cubic feet (table 8), or an average of 1,761 cubic feet per acre. The mature age class contains 218.7 million cubic feet, or 2,570 cubic feet per acre; the immature age class contains 648.2 million cubic feet, or 1,462 cubic feet per acre; and the all-aged stands contain 267.9 million cubic feet, or 2,307 cubic feet per acre.

Hardwood logs from mature stands in Grey County.

TABLE 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Lake Huron district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,063	2,402	71,373	36,271	....	....	111,109
Hardwood	32,716	168,619	225,772	146,924	76,825	151,403	802,259
Mixedwoods	3,136	11,470	111,290	73,586	14,101	28,367	241,950
TOTAL	36,915	182,491	408,435	256,781	90,926	179,770	1,155,318

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	927	1,478	60,323	21,155	....	....	83,883
Hardwood	911	2,902	6,713	4,831	2,274	4,577	22,208
Mixedwoods	1,517	3,255	49,424	19,053	5,576	6,666	85,491
TOTAL	3,355	7,635	116,460	45,039	7,850	11,243	191,582

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	136	924	11,050	15,116	....	....	27,226
Hardwood	31,805	165,717	219,059	142,093	74,551	146,826	780,051
Mixedwoods	1,619	8,215	61,866	54,533	8,525	21,701	156,459
TOTAL	33,560	174,856	291,975	211,742	83,076	168,527	963,736

Table 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Huron district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	3,620	1,829	....	....	5,449
Hardwood	93	470	4,321	2,728	868	1,689	10,169
Mixedwoods	33	140	2,724	1,752	68	137	4,854
Total	126	610	10,665	6,309	936	1,826	20,472

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	3,078	1,087	....	....	4,165
Hardwood	2	7	142	99	29	58	337
Mixedwoods	17	46	1,219	470	27	32	1,811
Total	19	53	4,439	1,656	56	90	6,313

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	542	742	....	....	1,284
Hardwood	91	463	4,179	2,629	839	1,631	9,832
Mixedwoods	16	94	1,505	1,282	41	105	3,043
Total	107	557	6,226	4,653	880	1,736	14,159

Table 8. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Huron district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	1,063	2,402	67,753	34,442	....	....	105,660
Hardwood	32,623	168,149	221,451	144,196	75,957	149,714	792,090
Mixedwoods	3,103	11,330	108,566	71,834	14,033	28,230	237,096
Total	36,789	181,881	397,770	250,472	89,990	177,944	1,134,846

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	927	1,478	57,245	20,068	....	....	79,718
Hardwood	909	2,895	6,571	4,732	2,245	4,519	21,871
Mixedwoods	1,500	3,209	48,205	18,583	5,549	6,634	83,680
Total	3,336	7,582	112,021	43,383	7,794	11,153	185,269

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	136	924	10,508	14,374	....	....	25,942
Hardwood	31,714	165,254	214,880	139,464	73,712	145,195	770,219
Mixedwoods	1,603	8,121	60,361	53,251	8,484	21,596	153,416
Total	33,453	174,299	285,749	207,089	82,196	166,791	949,577

Species

Within the Lake Huron district the hardwood species total 963.7 million cubic feet (table 9), or 83 per cent of the volume, and the coniferous species total 191.6 million cubic feet, or 17 per cent of the volume.

Seven species form 77 per cent of the volume on productive forest land (fig. 9). The principal species within the district are sugar maple which comprises 21 per cent of the growing stock and elm which forms 18 per cent. They are followed by white cedar with 10 per cent, poplar and soft maple with 9 per cent each, beech with 6 per cent and basswood with 4 per cent.

In the mature age class four species form 80 per cent of the total volume: sugar maple 33 per cent, elm 22 per cent, beech 14 per cent, and soft maple 11 per cent. Four species comprise 60 per cent of the immature volume; white cedar 16 per cent, sugar maple and elm 15 per cent each, and poplar 14 per cent. In the all-aged stands sugar maple forms 25 per cent of the total growing stock, elm 24 per cent and soft maple 12 per cent.

The 20 million cubic feet on Crown lands is made up of 69 per cent hardwoods and 31 per cent conifers (table 10). Eighty-three per cent of the volume on Crown lands occurs within the immature age class. The principal species within this age class are white cedar which makes up 24 per cent of the immature volume, sugar maple, elm and poplar which each comprise 13 per cent of the volume in this age class.

County Forests are sometimes established to stabilize areas of drifting sand.

Patented lands, which contain 98 per cent of the volume in the district, have 950 million cubic feet of hardwoods and 185 million cubic feet of conifers (table 11). The principal species on patented lands are sugar maple, elm, white cedar, poplar and soft maple. Sugar maple forms 33 per cent and elm 22 per cent of the mature volume. In the immature age class white cedar comprises 16 per cent of the volume, sugar maple and elm 15 per cent each and poplar 14 per cent. In the all-aged stands sugar maple forms 25 per cent of the volume, elm 24 per cent and soft maple 12 per cent.

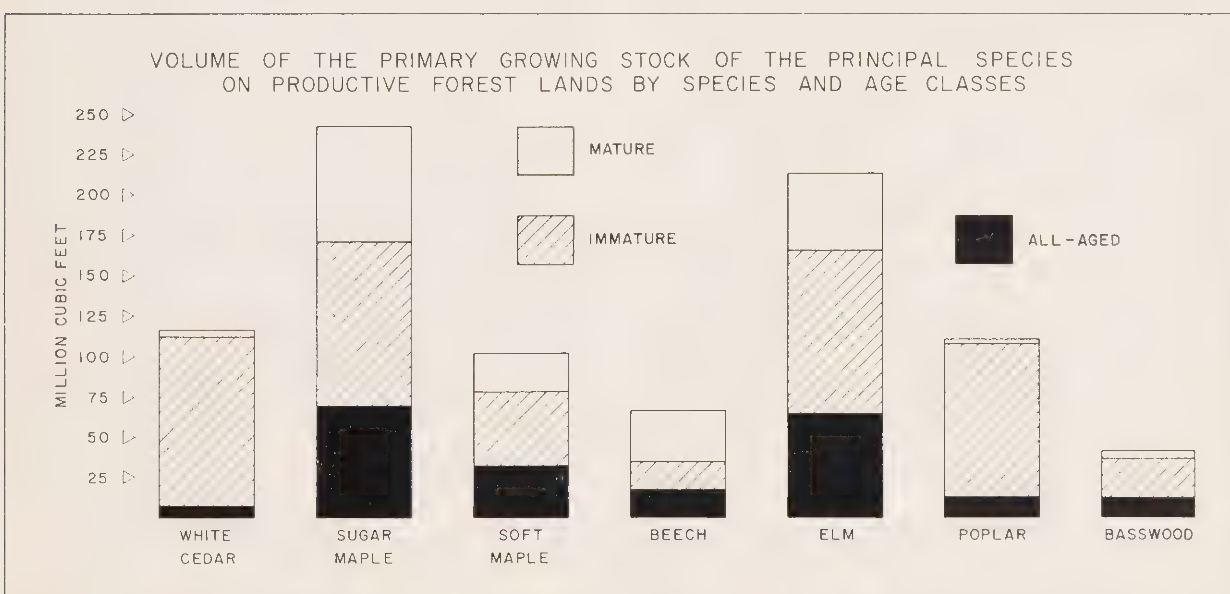


FIGURE 9

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4 to 9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller size material in the top which may be used as pulpwood or for purposes other than saw timber. The total quantity of wood in this residual top is relatively small and is included in the 10 inches and over material in all inventory estimates.

Fifty-four per cent of the volume in the Lake Huron district occurs in the sawlog size class and 46 per cent in the pulpwood size class. Of the hardwood volume, 555 million cubic feet, or 58 per cent, occurs in the larger size class and 409 million cubic feet, or 42 per cent, in the smaller. Conifers have

TABLE 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Lake Huron district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	101	1,165	2,069	6,832	535	2,620	13,322
Red pine	...	...	...	...	136	237	373
White spruce	4	18	3,297	2,594	154	278	6,345
Black spruce	...	...	59	...	...	...	59
Balsam fir	89	27	13,573	2,021	447	92	16,249
Hemlock	1,224	4,224	8,983	11,597	2,451	5,158	33,637
White cedar	1,930	2,175	84,141	20,741	3,874	2,695	115,556
Larch	7	26	4,338	1,254	253	163	6,041
TOTAL CONIFERS	3,355	7,635	116,460	45,039	7,850	11,243	191,582
Sugar maple	13,647	58,268	65,725	36,943	28,576	40,197	243,356
Soft maple	3,744	19,936	26,979	19,324	10,972	20,775	101,730
White birch	291	302	26,274	6,764	1,723	1,639	36,993
Yellow birch	1,281	2,375	9,716	7,542	2,758	3,300	26,972
Beech	1,941	29,777	6,324	10,600	3,376	13,782	65,800
Elm	6,175	42,141	39,656	61,205	14,621	49,229	213,027
Ironwood	952	561	5,118	570	1,968	396	9,565
Red oak	151	1,506	6,384	4,931	1,273	5,428	19,673
White oak	287	1,226	1,858	1,670	1,142	2,011	8,194
Poplar	646	1,903	62,814	33,167	4,270	7,566	110,366
Black ash	1,203	1,585	13,382	2,823	3,763	2,267	25,023
White ash	1,252	5,527	10,216	9,101	3,420	8,506	38,022
Basswood	1,007	7,785	7,449	12,879	2,437	9,908	41,465
Black cherry	528	1,100	5,876	2,603	1,474	2,199	13,780
Butternut	...	110	...	...	43	127	280
Walnut	...	110	...	...	...	...	110
Hickory	455	644	4,204	1,620	1,260	1,197	9,380
TOTAL HARDWOODS	33,560	174,856	291,975	211,742	83,076	168,527	963,736
TOTAL ALL SPECIES	36,915	182,491	408,435	256,781	90,926	179,770	1,155,318

TABLE 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Huron district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	1	11	71	246	4	21	354
Red pine	...	...	...	...	1	1	2
White spruce	...	...	124	84	1	1	210
Black spruce	...	...	...	...	...	...	...
Balsam fir	1	...	494	78	2	1	576
Hemlock	7	29	301	405	22	48	812
White cedar	10	13	3,303	803	24	17	4,170
Larch	...	...	146	40	2	1	189
TOTAL CONIFERS	19	53	4,439	1,656	56	90	6,313
Sugar maple	35	155	1,384	819	354	489	3,236
Soft maple	12	72	533	368	110	201	1,296
White birch	1	2	694	185	17	17	916
Yellow birch	5	12	241	203	25	30	516
Beech	6	86	109	203	34	144	582
Elm	21	146	790	1,343	141	475	2,916
Ironwood	3	2	103	14	21	5	148
Red oak	1	9	110	81	9	50	260
White oak	2	7	13	9	6	9	46
Poplar	3	9	1,454	822	44	74	2,406
Black ash	4	4	312	71	41	26	458
White ash	6	20	166	156	31	86	465
Basswood	3	26	149	311	24	101	614
Black cherry	2	4	118	49	15	22	210
Butternut	...	...	...	...	...	...	...
Walnut	...	...	...	...	...	...	...
Hickory	3	3	50	19	8	7	90
TOTAL HARDWOODS	107	557	6,226	4,653	880	1,736	14,159
TOTAL ALL SPECIES	126	610	10,665	6,309	936	1,826	20,472

Rocky land in Miller Lake Forest has produced a crop of Scots pine Christmas trees.

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Huron district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	100	1,154	1,998	6,586	531	2,599	12,968
Red pine	....	....	....	....	135	236	371
White spruce	4	18	3,173	2,510	153	277	6,135
Black spruce	....	....	59	....	....	....	59
Balsam fir	88	27	13,079	1,943	445	91	15,673
Hemlock	1,217	4,195	8,682	11,192	2,429	5,110	32,825
White cedar	1,920	2,162	80,838	19,938	3,850	2,678	111,386
Larch	7	26	4,192	1,214	251	162	5,852
TOTAL CONIFERS	3,336	7,582	112,021	43,383	7,794	11,153	185,269
Sugar maple	13,612	58,113	64,341	36,124	28,222	39,708	240,120
Soft maple	3,732	19,864	26,446	18,956	10,862	20,574	100,434
White birch	290	300	25,580	6,579	1,706	1,622	36,077
Yellow birch	1,276	2,363	9,475	7,339	2,733	3,270	26,456
Beech	1,935	29,691	6,215	10,397	3,342	13,638	65,218
Elm	6,154	41,995	38,866	59,862	14,480	48,754	210,111
Ironwood	949	559	5,015	556	1,947	391	9,417
Red oak	150	1,497	6,274	4,850	1,264	5,378	19,413
White oak	285	1,219	1,845	1,661	1,136	2,002	8,148
Poplar	643	1,894	61,360	32,345	4,226	7,492	107,960
Black ash	1,199	1,581	13,070	2,752	3,722	2,241	24,565
White ash	1,246	5,507	10,050	8,945	3,389	8,420	37,557
Basswood	1,004	7,759	7,300	12,568	2,413	9,807	40,851
Black cherry	526	1,096	5,758	2,554	1,459	2,177	13,570
Butternut	....	110	....	....	43	127	280
Walnut	....	110	....	....	....	....	110
Hickory	452	641	4,154	1,601	1,252	1,190	9,290
TOTAL HARDWOODS	33,453	174,299	285,749	207,089	82,196	166,791	949,577
TOTAL ALL SPECIES	36,789	181,881	397,770	250,472	89,990	177,944	1,134,846

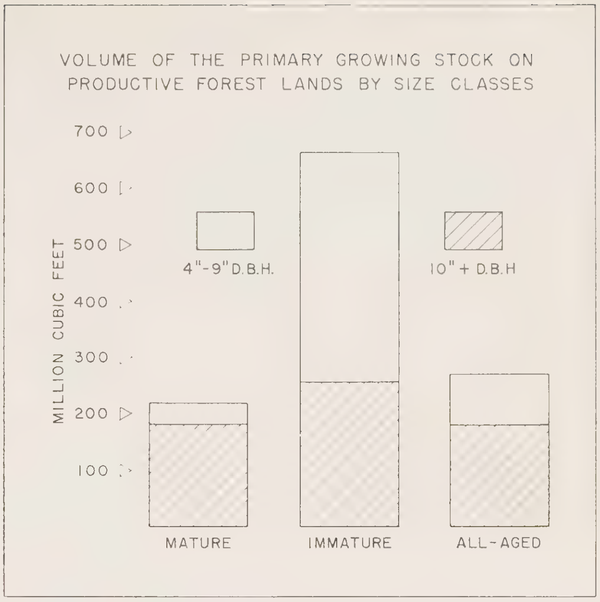


FIGURE 10

128 million cubic feet, or 67 per cent, in the 4 to 9-inch class and 64 million cubic feet, or 33 per cent, in the 10-inch and over size class (table 9). The sawlog size class contains 83 per cent of the mature volume and 66 per cent of the volume in all-aged stands. In the immature age class, 61 per cent of the volume occurs in the cordwood size class (fig. 10).

On Crown lands, 57 per cent of the volume occurs in the 4 to 9-inch class and 43 per cent in the 10-inch and over class. While 72 per cent of the coniferous volume occurs in the smaller size class, only 51 per cent of the hardwood volume is found in this category (table 10).

The 10-inch and over size class contains 54 per cent of the volume on patented lands in the Lake Huron district (table 11). While this size class contains 58 per cent of the hardwood volume, only 34 per cent of the coniferous volume occurs in this d.b.h. group. Within this ownership classification, the mature and all-aged stands are primarily sawlog producers, having 83 and 66 per cent, respectively, in this size class. The immature stands, however, have 61 per cent of their volume in the pulpwood or cordwood class.

The principal species in the mature age class on patented lands produce mainly sawlog size material. The 10-inch and over d.b.h. class contains 78 per cent of the mature hemlock, 81 per cent of the sugar

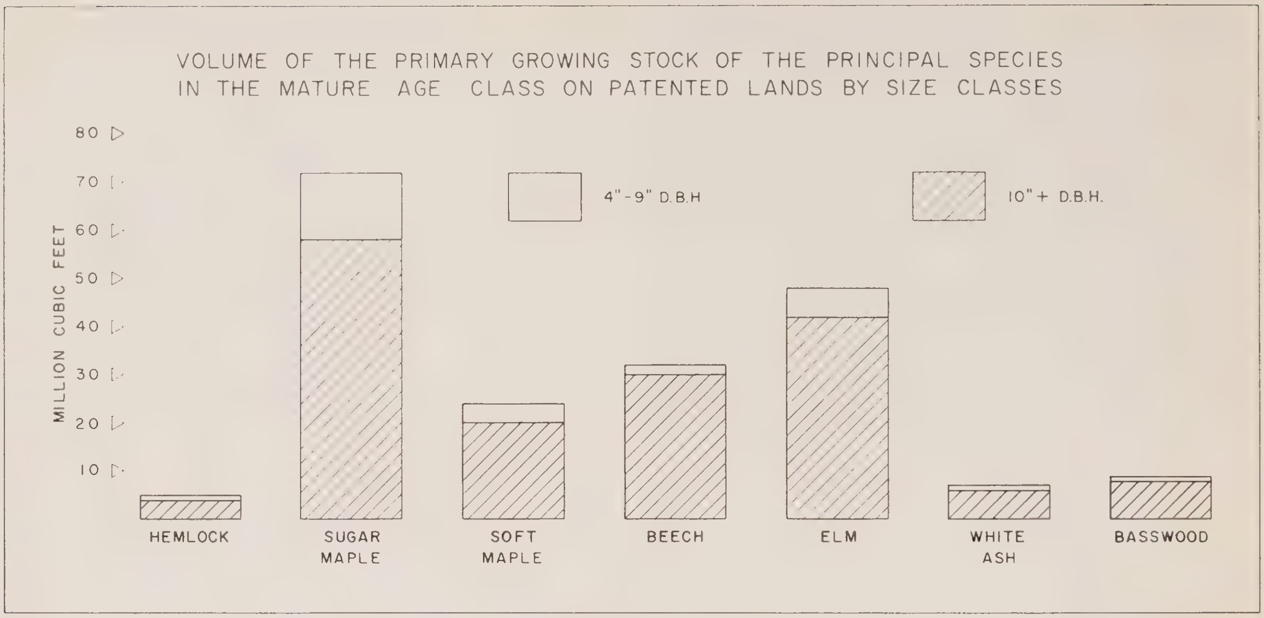


FIGURE 11

maple, 84 per cent of the soft maple, 94 per cent of the beech, 87 per cent of the elm, 82 per cent of the white ash and 89 per cent of the basswood (fig. 11). With the exception of white pine, hemlock, beech, elm and basswood, the species in the immature age class occur mainly in the 4 to 9-inch size class. For the principal species in this age class, the 4 to 9-inch class contains 44 per cent of the hemlock, 80 per cent of the white cedar, 64 per cent of the sugar maple, 58 per cent of the soft maple, 39 per cent of the elm, 65 per cent of the poplar and 37 per cent of the basswood (fig. 12). The all-aged stands on patented lands produce primarily sawlog size material. This size class contains 58 per cent of the sugar maple, 65 per cent of the soft maple, 80 per cent of the beech, 77 per cent of the elm, 64 per cent of the poplar, 71 per cent of the white ash and 80 per cent of the basswood (fig. 13).

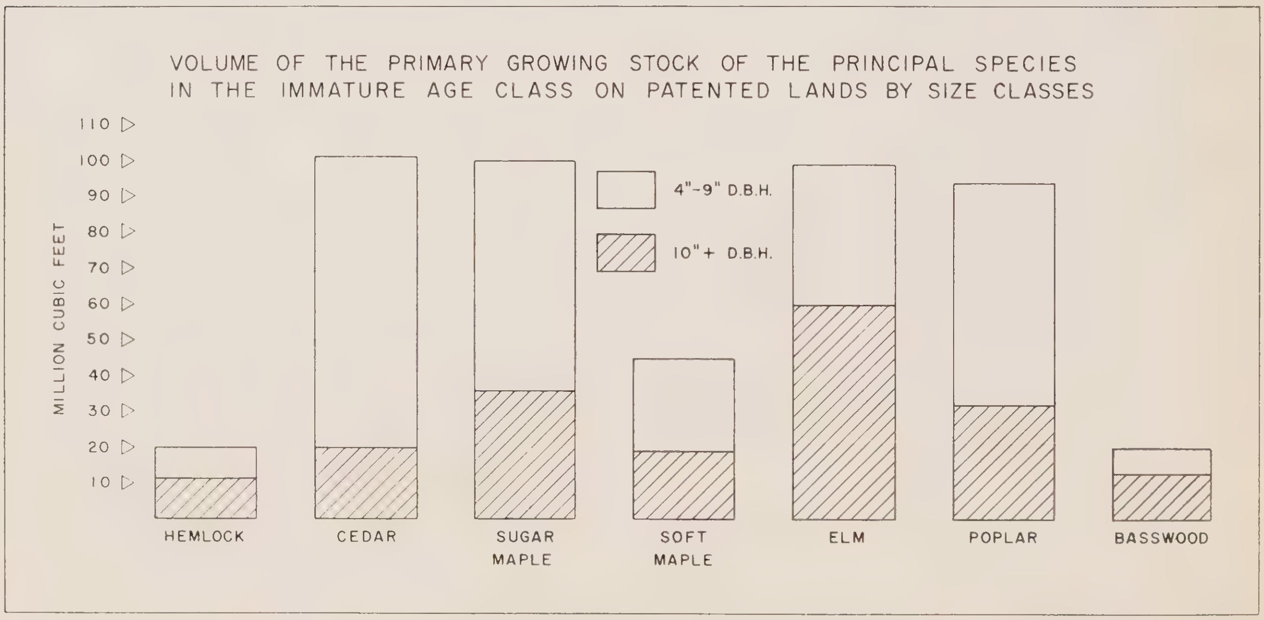


FIGURE 12

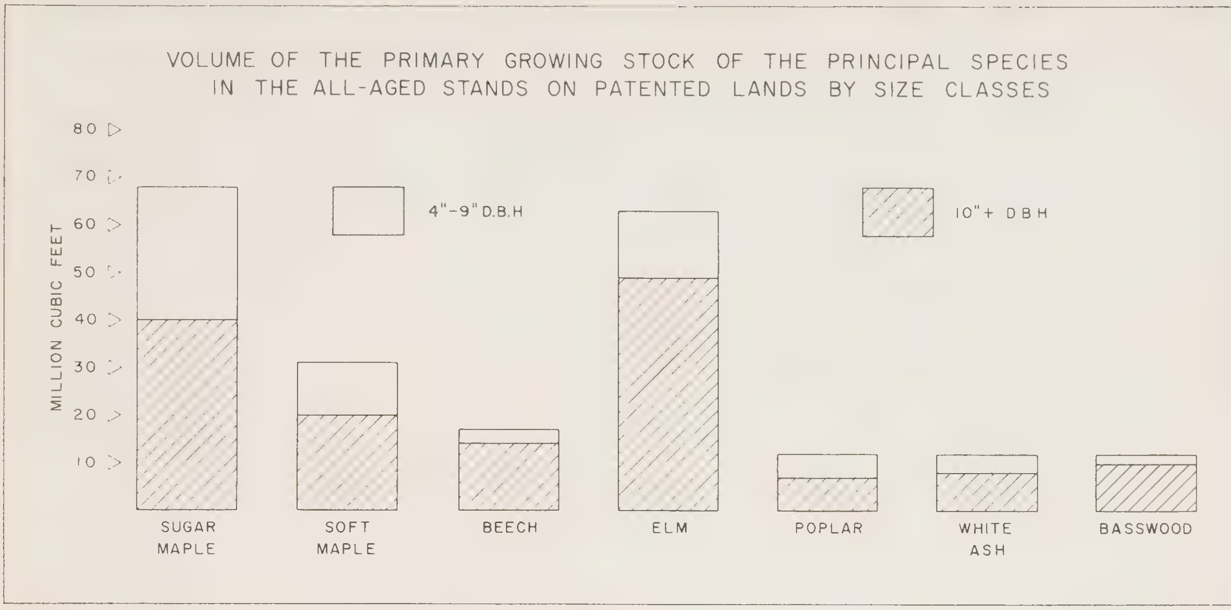


FIGURE 13

Allowable Cut

The allowable cut has been computed for each species with the aid of a volumetric formula[1] and appropriate rotation[2] for the species. Thus the amount of the allowable cut results from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

The calculation of allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. The size and structure of the primary growing stock, upon which the allowable cut calculations are based, changes from year to year, owing to woods operations and growth of the stands. Because of this, the allowable cut should be recalculated on expiration of the initial ten-year period. With effective forestry practices, allowable cuts for the valuable species will increase; without them, the proportion of less desirable species in the stands will grow greater.

The annual allowable cut, or net depletion, permissible under management in the Lake Huron district is 29,398,625 cubic feet: 16,115 cubic feet from Crown lands and 29,382,510 cubic feet from patented lands. Of the total allowable cut, 99.9 per cent is on patented lands.

[1] Method of calculation of allowable cut is given in Appendix, methods, allowable cut, page 29.

[2] Rotation, by species, table 15, page 29.

CROWN LAND

The annual allowable cut for Crown land represents only 0.1 per cent of the primary growing stock, or 0.8 cubic feet per acre for the productive forest area. The permissible cut of 16,115 cubic feet (table 12) is composed primarily of deciduous

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Lake Huron district.*

Species	Annual allowable cut
	cu. ft.
White pine	300
Balsam fir	35
Hemlock	360
White cedar	345
TOTAL CONIFERS	1,040
Sugar maple	2,850
Soft maple	3,600
White birch	110
Yellow birch	340
Beech	1,380
Elm	3,340
Ironwood	150
Red oak	150
White oak	90
Poplar	720
Black ash	240
White ash	780
Basswood	965
Black cherry	180
Hickory	180
TOTAL HARDWOODS	15,075
TOTAL ALL SPECIES	16,115

species. Four species comprise 69 per cent of the present allowable cut: sugar maple 18 per cent, soft maple 22 per cent, beech 8 per cent and elm 21 per cent.

Patented Land

The annual allowable cut for patented lands is 29,382,510 cubic feet (table 13). This represents 2.6 per cent of the primary growing stock, or 40.9 cubic feet per acre for the productive forest land. The annual allowable cut is 1.9 per cent of the primary growing stock for conifers and 2.7 per cent for hardwoods.

Coniferous species comprise 12 per cent of the allowable cut. White cedar forms 58 per cent of the coniferous allowable cut, but this represents only 7.1 per cent of the allowable cut for patented lands.

Seventy-six per cent of the hardwood allowable cut is obtained from four of the seventeen hardwood species. Soft maple forms 18 per cent of the allowable cut, elm 15 per cent, poplar 26 per cent, and sugar maple 17 per cent. Figure 14 graphically illustrates the relationship of the allowable cut for a ten-year period to the volume of the primary growing stock for the principal species.

TABLE 13. — *Annual allowable cut for all species on patented lands in the Lake Huron district.*

Species	Annual allowable cut
	cu. ft.
White pine	270,165
Red pine	11,595
White spruce	191,720
Black spruce	1,230
Balsam fir	489,780
Hemlock	410,310
White cedar	2,088,490
Larch	146,300
TOTAL CONIFERS	3,609,590
Sugar maple	4,502,250
Soft maple	4,707,845
White birch	1,127,405
Yellow birch	413,375
Beech	815,225
Elm	3,939,580
Ironwood	176,570
Red oak	363,995
White oak	101,850
Poplar	6,747,500
Black ash	460,595
White ash	704,195
Basswood	1,276,595
Black cherry	254,440
Butternut	5,250
Walnut	2,060
Hickory	174,190
TOTAL HARDWOODS	25,772,920
TOTAL ALL SPECIES	29,382,510

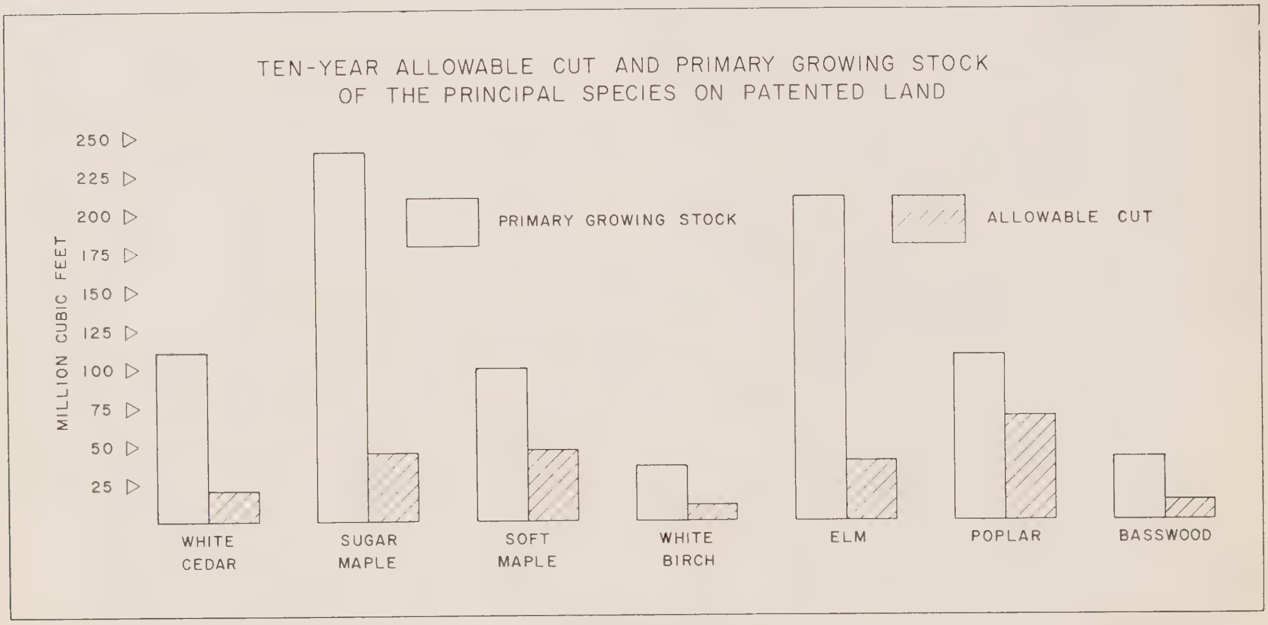


FIGURE 14

White cedar growing on a wet site in County Forest.

Utilization vs. Allowable Cut

No statistics relating to the annual cut of timber on Crown lands in the Lake Huron district are collected by the Department of Lands and Forests. This district is essentially an area of privately owned lands for which data pertaining to timber production are not readily available. The volume and value of products produced from farm woodlots in 1950[1] is as follows:

Fuelwood	161,163 cords
Pulpwood	315 cords
Posts	119,112 pieces
Logs	10,464,220 board feet
Poles	4,464 pieces

The above products were estimated[1] to have a value of $1,863,523 and to have produced, through sales, a cash income of $725,398. In addition, maple syrup and maple sugar production within the district was valued at $195,482, of which $124,649 represented a cash income to the farmers. These data do not include the number or value of Christmas trees sold from private lands in the district.

By the use of appropriate converting factors, these wood volumes are expressed in gross total cubic feet (table 14). Since these volumes can not be separated by species, no detailed comparison of actual and allowable cut is possible. A comparison of the total actual cut with the total allowable cut indicates that the patented lands in the district are being overcut by some 7,698,418 cubic feet. This overcut represents 26 per cent of the permissible cut under management in the district.

TABLE 14. — *Gross total cubic-foot volume of wood produced from patented land in one year in the Lake Huron district.*

Fuelwood	29,146,500
Pulpwood	56,968
Fence posts	337,109
Logs	7,414,011
Poles	126,340
TOTAL	37,080,928

[1] Census of Canada, 1951, Volume VI, Table 27.

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs at a scale of four inches to the mile (1/15,840). Following the photography, semi-controlled photo maps were prepared.

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario, a photo map covers 7′30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map, the prints are mounted on a hard-surface, non-porous board, such as masonite, upon which control points have been plotted. The road net work of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges are feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted, and makes the edges of the prints less perceptible to the eye and to the camera. After a liberal application of adhesive, the print is oriented on to the control and adjusted to coincide with the detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the mosaic it is photographed in two sections, producing an east and a west half for each sheet. Upon production of the negative, prints are readily available.

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the mosaic. Forest data were drafted on a linen overlay, and the ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by the field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1954 and 1955; field sampling was carried out in the summers of 1956 and 1957. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. These were separated into three age classes: mature, immature and all-aged. The volume per acre for each cover type for the mature and immature age classes was then summarized from the field tallies into three density classes. The all-aged stands were not segregated into density classes. Summaries were made separately for the two ecological sections in the Lake Huron district and for the different years during which field data were collected. The per acre volumes in cubic feet, made up in this manner, are shown in tables 16, 17 and 18.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by dividing the total mature volume for each species by the respective rotation age. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 19 cubic feet per acre, and for patented lands to 30 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years and the mature age class from 30 to 300 years, depending on the species. Stands classed

[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department of Lands and Forests, Ontario, Parts II and III.

as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 15).

TABLE 15. — *Rotation by species.*

Species	Crown land	Patented land
	years	*years*
White pine	120	90
Red pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100
Butternut	100	100
Walnut	100	100
Hickory	100	100

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotations.

The compilation was carried out in such a way that volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

(b) FORMULA

In the present calculations, the following formulae were used:

$$\text{(1) Crown land:} \quad P = \frac{V.1.}{n/3}$$

$$\text{(2) Patented land:} \quad P = \frac{\frac{5}{8}\,(V.1. + V.2. + V.3.)}{n/3}$$

where:

V.1. — denotes volume of mature timber (Age Class I).
V.2. — denotes volume of immature timber (Age Class II).
V.3. — denotes volume of mature and immature timber in all-aged stands.
n — denotes rotation.
P — denotes allowable cut.

Formula (1) was used for Crown lands, since it is the practice in Ontario to limit utilization on these areas to mature timber. In addition, much of the Crown forest within the district occurs on county and authority forests where it is the present aim to build up the growing stock, rather than to deplete it through operations in immature timber. A considerable proportion also occurs in Provincial Parks, where aesthetic values are likely to be given preference over straight timber values. In view of these considerations, it is felt that during the present rotation, only a limited amount of timber will be extracted from Crown lands.

On patented lands, formula (2) was used since it is reasonable to assume that with a high population and a heavy demand for wood, the owners of these lands will be willing to utilize a portion of their immature stands to satisfy this demand.

With the aid of the above formulae, the allowable cut has been calculated for each species, separately, with full consideration of the actual growing stock of each species and the appropriate rotation. The results of individual calculations for each species have been totalled and shown as allowable cut for Crown lands and for patented lands, respectively.

[1] Manual of Timber Management, Department of Lands and Forests, Ontario, Part II, page 50.

[2] L. Pardé — Traité pratique d'aménagement des forêts, Paris, 1930.

TABLE 16. — *Volume of the primary growing stock in cubic feet per acre.*
Huron Section — 1956

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I) Density Class 1	2	3	CONIFEROUS IMMATURE (C-II) Density Class 1	2	3	ALL-AGED
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	18.7	15.9	9.9	20.9	16.5	9.2	....
	10″ up	120.7	102.8	64.3	75.0	59.2	33.2	....
White spruce	4″–9″	3.0	2.5	1.6	35.0	27.6	15.5	....
	10″ up	13.2	11.3	7.0	20.1	15.9	8.9	....
Balsam fir	4″–9″	35.0	29.8	18.6	126.8	100.1	56.0	....
	10″ up	20.1	17.1	10.7	21.8	17.3	9.7	....
Hemlock	4″–9″	127.8	108.8	68.0	72.5	57.2	32.0	....
	10″ up	361.7	307.9	192.5	100.1	79.1	44.3	....
White cedar	4″–9″	682.1	580.7	362.9	1055.6	833.6	466.8	....
	10″ up	861.1	733.0	458.2	250.8	198.1	110.9	....
Larch	4″–9″	0.7	0.6	0.4	44.8	35.4	19.9	....
	10″ up	5.8	4.9	3.1	10.3	8.1	4.5	....
TOTAL CONIFERS	4″–9″	867.3	738.3	461.4	1355.6	1070.4	599.4	....
	10″ up	1382.6	1177.0	735.8	478.1	377.7	211.5	....
Sugar maple	4″–9″	10.2	8.7	5.4	6.6	5.2	2.9	....
	10″ up	151.9	129.3	80.9	34.1	27.0	15.1	....
Soft maple	4″–9″	8.7	7.4	4.6	17.2	13.6	7.6	....
	10″ up	46.4	39.5	24.7	16.4	12.9	7.2	....
White birch	4″–9″	16.5	14.0	8.8	51.7	40.8	22.9	....
	10″ up	19.2	16.4	10.2	20.2	16.0	8.9	....
Yellow birch	4″–9″	35.3	30.1	18.8	30.7	24.2	13.6	....
	10″ up	120.3	102.4	64.0	29.2	23.1	12.9	....
Beech	4″–9″	4.9	4.2	2.6	0.9	0.7	0.4	....
	10″ up	131.3	111.7	69.9	11.1	8.8	4.9	....
Elm	4″–9″	15.4	13.1	8.2	34.3	27.1	15.2	....
	10″ up	221.3	188.4	117.7	97.5	77.0	43.1	....
Ironwood	4″–9″	7.1	6.1	3.8	1.1	0.9	0.5	....
	10″ up	9.1	7.7	4.8	1.3	1.0	0.6	....
Red oak	4″–9″	....	....	....	0.4	0.3	0.2	....
	10″ up	6.5	5.5	3.4	2.0	1.6	0.9	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar (all)	4″–9″	13.0	11.0	6.9	75.9	59.9	33.6	....
	10″ up	61.6	52.5	32.8	70.3	55.6	31.1	....
Black ash	4″–9″	12.0	10.2	6.4	13.5	10.6	6.0	....
	10″ up	4.2	3.6	2.2	5.7	4.5	2.5	....
White ash	4″–9″	0.9	0.8	0.5	1.2	0.9	0.5	....
	10″ up	5.6	4.7	3.0	8.4	6.7	3.7	....
Basswood	4″–9″	3.2	2.7	1.7	1.7	1.3	0.7	....
	10″ up	81.1	69.1	43.1	27.1	21.4	12.0	....
Black cherry	4″–9″	0.2	0.2	0.1	2.4	1.9	1.0	....
	10″ up	3.0	2.6	1.6	2.4	1.9	1.1	....
TOTAL HARDWOODS	4″–9″	127.4	108.5	67.8	237.6	187.4	105.1	....
	10″ up	864.7	736.2	460.0	325.7	257.5	144.0	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1593.2	1257.8	704.5	....
	10″ up	2247.3	1913.2	1195.8	803.8	635.2	355.5	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2397.0	1893.0	1060.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	0.5	0.4	0.3	2.9	2.4	1.5	2.3
	10″ up	11.1	9.5	6.0	3.7	3.2	2.0	19.0
White spruce	4″–9″	....	....	....	1.7	1.4	0.9	0.5
	10″ up	....	....	....	1.6	1.4	0.8	0.2
Balsam fir	4″–9″	....	....	....	5.9	5.0	3.1	1.6
	10″ up	....	....	....	0.7	0.6	0.4	0.3
Hemlock	4″–9″	12.5	10.6	6.7	7.7	6.5	4.1	10.2
	10″ up	48.3	41.1	26.2	12.0	10.2	6.4	26.6

TABLE 16 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*)			HARDWOODS IMMATURE (H-II) (*Cont'd*)			HARDWOODS ALL-AGED (*Cont'd*)
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White cedar	4″–9″	7.1	6.0	3.8	13.6	11.5	7.2	8.8
	10″ up	7.4	6.3	4.0	2.8	2.4	1.5	4.9
Larch	4″–9″	....	....	....	1.0	0.9	0.6	0.4
	10″ up	....	....	....	0.6	0.5	0.3	0.4
TOTAL CONIFERS	4″–9″	20.1	17.0	10.8	32.8	27.7	17.4	23.8
	10″ up	66.8	56.9	36.2	21.4	18.3	11.4	51.4
Sugar maple	4″–9″	232.5	197.7	125.6	337.5	286.3	179.5	305.1
	10″ up	1073.9	913.1	580.2	181.7	154.2	96.7	438.8
Soft maple	4″–9″	29.3	24.9	15.8	86.1	73.0	45.8	55.1
	10″ up	130.0	110.6	70.3	47.0	39.9	25.0	105.1
White birch	4″–9″	8.5	7.3	4.6	72.2	61.3	38.4	13.5
	10″ up	8.9	7.5	4.8	14.9	12.6	7.9	15.1
Yellow birch	4″–9″	12.3	10.5	6.6	14.1	12.0	7.5	11.7
	10″ up	19.6	16.6	10.6	8.9	7.5	4.7	15.5
Beech	4″–9″	32.4	27.6	17.5	26.9	22.8	14.3	30.5
	10″ up	474.6	403.4	256.4	38.8	33.0	20.6	111.1
Elm	4″–9″	50.8	43.2	27.5	90.9	77.2	48.4	70.4
	10″ up	447.5	380.4	241.7	132.5	112.4	70.5	274.1
Ironwood	4″–9″	14.2	12.0	7.6	21.9	18.6	11.7	17.1
	10″ up	9.0	7.7	4.9	2.7	2.3	1.4	3.7
Red oak	4″–9″	0.8	0.7	0.4	34.7	29.5	18.5	8.3
	10″ up	16.6	14.1	9.0	22.8	19.3	12.1	44.5
White oak	4″–9″	....	....	....	0.9	0.8	0.5	0.7
	10″ up	2.9	2.5	1.6	0.7	0.6	0.4	3.1
Poplar (all)	4″–9″	6.5	5.6	3.5	210.2	178.3	111.8	30.2
	10″ up	25.4	21.5	13.7	79.0	67.0	42.0	55.0
Black ash	4″–9″	11.5	9.8	6.2	33.7	28.6	18.0	27.2
	10″ up	14.6	12.4	7.9	7.4	6.3	3.9	17.2
White ash	4″–9″	7.7	6.5	4.1	23.9	20.3	12.7	17.7
	10″ up	58.9	50.1	31.8	20.5	17.3	10.9	56.7
Basswood	4″–9″	11.7	9.9	6.3	22.2	18.8	11.8	13.9
	10″ up	98.4	83.7	53.1	37.0	31.4	19.7	58.5
Black cherry	4″–9″	4.1	3.4	2.2	13.9	11.8	7.4	6.2
	10″ up	7.5	6.4	4.1	5.8	4.9	3.1	10.8
TOTAL HARDWOODS	4″–9″	422.3	359.1	227.9	989.1	839.3	526.3	607.6
	10″ up	2387.8	2030.0	1290.1	599.7	508.7	318.9	1209.2
GRAND TOTAL	4″–9″	442.4	376.1	238.7	1021.9	867.0	543.7	631.4
	10″ up	2454.6	2086.9	1326.3	621.1	527.0	330.3	1260.6
TOTAL 4″ UP		2897.0	2463.0	1565.0	1643.0	1394.0	874.0	1892.0
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	11.0	9.4	5.9	5.7	4.8	3.1	18.1
	10″ up	208.5	178.2	112.7	24.8	21.2	13.6	69.7
White spruce	4″–9″	1.2	1.0	0.6	15.6	13.4	8.6	3.8
	10″ up	4.9	4.2	2.7	13.1	11.1	7.1	5.5
Balsam fir	4″–9″	11.8	10.1	6.4	75.8	64.6	41.3	18.2
	10″ up	6.5	5.5	3.5	10.4	8.9	5.7	4.8
Hemlock	4″–9″	123.5	105.5	66.8	37.8	32.2	20.6	68.1
	10″ up	458.9	392.3	248.1	48.4	41.3	26.4	112.9
White cedar	4″–9″	144.4	123.3	78.0	338.6	289.0	184.8	152.4
	10″ up	209.4	179.0	113.2	86.8	74.1	47.4	100.2
Larch	4″–9″	....	....	....	15.4	13.2	8.5	2.5
	10″ up	3.0	2.6	1.6	6.1	5.2	3.3	2.6
TOTAL CONIFERS	4″–9″	291.9	249.3	157.7	488.9	417.2	266.9	263.1
	10″ up	891.2	761.8	481.8	189.6	161.8	103.5	295.7

TABLE 16 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class			MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class			MIXEDWOODS ALL-AGED (*Cont'd*)
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	60.2	51.4	32.5	22.6	19.3	12.3	62.4
	10″ up	375.9	321.4	203.2	20.5	17.5	11.2	155.2
Soft maple	4″–9″	23.3	19.9	12.6	40.0	34.1	21.8	34.8
	10″ up	92.6	79.1	50.0	35.4	30.2	19.4	65.8
White birch	4″–9″	17.4	14.8	9.4	137.2	117.1	74.9	36.5
	10″ up	43.6	37.3	23.6	36.9	31.5	20.2	45.4
Yellow birch	4″–9″	47.6	40.7	25.7	42.2	36.0	23.0	34.9
	10″ up	138.4	118.3	74.8	38.6	33.0	21.1	55.7
Beech	4″–9″	17.8	15.2	9.6	2.8	2.4	1.5	13.2
	10″ up	299.3	255.8	161.8	6.1	5.3	3.4	76.3
Elm	4″–9″	34.2	29.2	18.5	77.5	66.2	42.3	72.4
	10″ up	398.7	340.9	215.5	170.2	145.2	92.9	337.9
Ironwood	4″–9″	8.6	7.4	4.6	6.3	5.3	3.4	6.6
	10″ up	6.6	5.6	3.6	0.9	0.8	0.5	0.5
Red oak	4″–9″	1.6	1.4	0.9	2.1	1.8	1.1	2.8
	10″ up	25.8	22.0	13.9	3.3	2.8	1.8	11.4
White oak	4″–9″	0.1	0.1	0.1	....	....	....	....
	10″ up	2.9	2.5	1.5	....	....	....	.....
Poplar (all)	4″–9″	12.6	10.8	6.8	202.3	172.6	110.5	41.9
	10″ up	42.3	36.1	22.9	151.3	129.2	82.6	110.4
Black ash	4″–9″	21.1	18.1	11.4	47.6	40.7	26.0	21.5
	10″ up	12.4	10.6	6.7	8.0	6.8	4.4	14.0
White ash	4″–9″	7.8	6.6	4.2	6.8	5.8	3.7	9.3
	10″ up	28.8	24.7	15.6	7.6	6.5	4.1	13.2
Basswood	4″–9″	9.6	8.2	5.2	10.2	8.7	5.6	16.1
	10″ up	118.4	101.2	64.0	29.3	25.0	16.0	63.7
Black cherry	4″–9″	6.9	5.8	3.7	7.7	6.6	4.2	3.8
	10″ up	11.4	9.8	6.2	3.1	2.6	1.7	5.5
TOTAL HARDWOODS	4″–9″	268.8	229.6	145.2	605.3	516.6	330.3	356.2
	10″ up	1597.1	1365.3	863.3	511.2	436.4	279.3	955.0
GRAND TOTAL	4″–9″	560.7	478.9	302.9	1094.2	933.8	597.2	619.3
	10″ up	2488.3	2127.1	1345.1	700.8	598.2	382.8	1250.7
TOTAL 4″ UP		3049.0	2606.0	1648.0	1795.0	1532.0	980.0	1870.0

Scots pine plantation, 30 years old, currently being thinned for pulpwood.

TABLE 17. — *Volume of the primary growing stock in cubic feet per acre. Huron Section — 1957*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	18.7	15.9	9.9	9.8	7.8	4.6	....
	10″ up	120.7	102.8	64.3	159.4	126.0	75.5	....
White spruce	4″–9″	3.0	2.5	1.6	68.0	53.8	32.2	....
	10″ up	13.2	11.3	7.0	34.6	27.3	16.4	....
Black spruce	4″–9″	....	....	....	16.6	13.2	7.9	....
	10″ up	....	....	....	....	....	....	....
Balsam fir	4″–9″	35.0	29.8	18.6	208.2	164.7	98.6	....
	10″ up	20.1	17.1	10.7	24.7	19.5	11.7	....
Hemlock	4″–9″	127.8	108.8	68.0	11.5	9.1	5.4	....
	10″ up	361.7	307.9	192.5	38.4	30.4	18.2	....
White cedar	4″–9″	682.1	580.7	362.9	1039.6	822.2	492.2	....
	10″ up	861.1	733.0	458.2	205.5	162.5	97.3	....
Larch	4″–9″	0.7	0.6	0.4	61.0	48.3	28.9	....
	10″ up	5.8	4.9	3.1	....	....	....	....
TOTAL CONIFERS	4″–9″	867.3	738.3	461.4	1414.7	1119.1	669.8	....
	10″ up	1382.6	1177.0	735.8	462.6	365.7	219.1	....
Sugar maple	4″–9″	10.2	8.7	5.4	1.7	1.4	0.8	....
	10″ up	151.9	129.3	80.9	20.5	16.1	9.7	....
Soft maple	4″–9″	8.7	7.4	4.6	11.2	8.8	5.3	....
	10″ up	46.4	39.5	24.7	....	....	....	....
White birch	4″–9″	16.5	14.0	8.8	104.7	82.8	49.6	....
	10″ up	19.2	16.4	10.2	67.2	53.2	31.8	....
Yellow birch	4″–9″	35.3	30.1	18.8	44.1	34.9	20.9	....
	10″ up	120.3	102.4	64.0	50.2	39.7	23.7	....
Beech	4″–9″	4.9	4.2	2.6	....	....	....	....
	10″ up	131.3	111.7	69.9	27.7	21.9	13.1	....
Elm	4″–9″	15.4	13.1	8.2	53.7	42.4	25.4	....
	10″ up	221.3	188.4	117.7	170.9	135.2	81.0	....
Ironwood	4″–9″	7.1	6.1	3.8	....	....	....	....
	10″ up	9.1	7.7	4.8	....	....	....	....
Red oak	4″–9″	....	....	....	....	....	....	....
	10″ up	6.5	5.5	3.4	....	....	....	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar	4″–9″	13.0	11.0	6.9	163.0	128.9	77.2	....
	10″ up	61.6	52.5	32.8	167.0	132.0	79.1	....
Black ash	4″–9″	12.0	10.2	6.4	1.9	1.5	0.9	....
	10″ up	4.2	3.6	2.2	3.6	2.8	1.7	....
White ash	4″–9″	0.9	0.8	0.5	....	....	....	....
	10″ up	5.6	4.7	3.0	....	....	....	....
Basswood	4″–9″	3.2	2.7	1.7	....	....	....	....
	10″ up	81.1	69.1	43.1	....	....	....	....
Black cherry	4″–9″	0.2	0.2	0.1	3.2	2.6	1.5	....
	10″ up	3.0	2.6	1.6	5.1	4.0	2.4	....
TOTAL HARDWOODS	4″–9″	127.4	108.5	67.8	383.5	303.3	181.6	....
	10″ up	864.7	736.2	460.0	512.2	404.9	242.5	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1798.2	1422.4	851.4	....
	10″ up	2247.3	1913.2	1195.8	974.8	770.6	461.6	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2773.0	2193.0	1313.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	....	....	....	1.8	1.5	0.9	....
	10″ up	....	....	....	3.1	2.4	1.4	....
Balsam fir	4″–9″	....	....	....	2.5	2.0	1.2	....
	10″ up	....	....	....	....	....	....	....

Table 17 — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Hemlock	4″–9″	12.1	9.6	5.7	23.8	18.8	11.2	21.2
	10″ up	46.0	36.4	21.5	28.1	22.2	13.2	42.7
White cedar	4″–9″	4.0	3.2	1.9	24.8	19.5	11.7	7.2
	10″ up	3.3	2.6	1.5	9.8	7.8	4.6	8.3
Total Conifers	4″–9″	16.1	12.8	7.6	52.9	41.8	25.0	28.4
	10″ up	49.3	39.0	23.0	41.0	32.4	19.2	51.0
Sugar maple	4″–9″	260.7	206.4	122.1	366.4	289.3	172.1	299.4
	10″ up	1042.8	825.7	488.2	177.2	139.9	83.3	375.5
Soft maple	4″–9″	69.1	54.7	32.4	154.5	122.0	72.6	153.7
	10″ up	337.6	267.3	158.0	112.4	88.7	52.8	274.1
White birch	4″–9″	....	....	....	30.4	24.0	14.3	9.7
	10″ up	....	....	....	4.2	3.3	2.0	5.3
Yellow birch	4″–9″	20.7	16.4	9.7	25.4	20.1	12.0	28.1
	10″ up	37.4	29.6	17.5	14.1	11.1	6.6	30.2
Beech	4″–9″	26.4	20.9	12.4	21.8	17.2	10.2	24.2
	10″ up	547.3	433.4	256.2	49.9	39.4	23.5	126.1
Elm	4″–9″	110.1	87.2	51.6	278.5	219.9	130.8	190.4
	10″ up	699.6	553.9	327.5	341.8	269.8	160.6	544.1
Ironwood	4″–9″	15.3	12.1	7.2	23.7	18.7	11.1	19.0
	10″ up	10.1	8.0	4.7	1.0	0.8	0.5	4.4
Red oak	4″–9″	....	....	....	....	....	....	6.2
	10″ up	....	....	....	....	....	....	34.2
White oak	4″–9″	....	....	....	9.7	7.6	4.6	9.0
	10″ up	....	....	....	5.1	4.1	2.4	12.4
Poplar	4″–9″	7.0	5.5	3.3	175.9	138.8	82.6	38.4
	10″ up	14.8	11.7	6.9	56.4	44.6	26.5	49.5
Black ash	4″–9″	22.1	17.5	10.4	74.4	58.8	34.8	41.6
	10″ up	36.0	28.5	16.8	19.5	15.4	9.2	29.2
White ash	4″–9″	16.5	13.0	7.7	82.1	64.8	38.6	40.2
	10″ up	85.2	67.5	39.9	58.7	46.4	27.6	98.1
Basswood	4″–9″	16.8	13.3	7.9	61.4	48.5	28.9	27.7
	10″ up	143.0	113.2	66.9	79.4	62.7	37.3	116.1
Black cherry	4″–9″	10.3	8.1	4.8	59.1	46.6	27.7	22.7
	10″ up	18.7	14.9	8.8	20.0	15.8	9.4	31.6
Butternut	4″–9″	....	....	....	....	....	....	....
	10″ up	3.6	2.9	1.7	....	....	....	....
Walnut	4″–9″	....	....	....	....	....	....	....
	10″ up	3.6	2.9	1.7	....	....	....	....
Hickory	4″–9″	3.4	2.7	1.6	54.0	42.6	25.4	15.9
	10″ up	7.5	5.9	3.5	20.1	15.9	9.4	15.7
Total Hardwoods	4″–9″	578.4	457.8	271.1	1417.3	1118.9	665.7	926.2
	10″ up	2987.2	2365.4	1398.3	959.8	757.9	451.1	1746.5
GRAND TOTAL	4″–9″	594.5	470.6	278.7	1470.2	1160.7	690.7	954.6
	10″ up	3036.5	2404.4	1421.3	1000.8	790.3	470.3	1797.5
TOTAL 4″ UP		3631.0	2875.0	1700.0	2471.0	1951.0	1161.0	2752.1
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	13.3	10.5	6.3	1.7	1.3	0.8	0.5
	10″ up	124.1	98.0	59.0	17.1	13.5	8.2	22.8
White spruce	4″–9″	....	....	....	14.7	11.5	7.0	12.6
	10″ up	....	....	....	28.4	22.4	13.7	28.8
Balsam fir	4″–9″	16.2	12.8	7.7	70.3	55.4	33.7	26.2
	10″ up	....	....	....	10.4	8.2	5.0	4.3
Hemlock	4″–9″	111.1	87.7	52.8	62.4	49.2	29.9	55.1
	10″ up	357.5	282.4	169.9	45.2	35.6	21.7	123.1

TABLE 17 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1			MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1			MIXEDWOODS ALL-AGED (*Cont'd*)
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White cedar	4″–9″	294.9	232.9	140.1	512.7	404.1	245.9	208.9
	10″ up	294.9	233.0	140.2	141.2	111.3	67.8	150.0
Larch	4″–9″	1.7	1.4	0.8	50.3	39.7	24.1	28.0
	10″ up	6.4	5.0	3.0	14.3	11.2	6.9	15.9
TOTAL CONIFERS	4″–9″	437.2	345.3	207.7	712.1	561.2	341.4	331.3
	10″ up	782.9	618.4	372.1	256.6	202.2	123.3	344.9
Sugar maple	4″–9″	50.9	40.2	24.2	40.3	31.7	19.3	77.4
	10″ up	203.6	160.8	96.8	40.4	31.9	19.4	130.0
Soft maple	4″–9″	78.4	61.9	37.2	80.4	63.4	38.6	36.1
	10″ up	454.9	359.3	216.2	86.4	68.1	41.4	48.1
White birch	4″–9″	29.1	23.0	13.8	124.3	98.0	59.6	40.0
	10″ up	19.4	15.3	9.2	42.5	33.5	20.4	33.1
Yellow birch	4″–9″	80.1	63.3	38.1	89.0	70.2	42.7	74.4
	10″ up	166.3	131.4	79.0	75.2	59.3	36.1	89.3
Beech	4″–9″	6.4	5.0	3.0	2.2	1.8	1.1	8.4
	10″ up	199.6	157.7	94.9	30.1	23.7	14.4	113.1
Elm	4″–9″	92.4	73.0	43.9	98.1	77.3	47.1	79.1
	10″ up	1034.8	817.3	491.9	243.7	192.1	116.9	615.8
Ironwood	4″–9″	6.8	5.4	3.2	4.6	3.5	2.2	7.3
	10″ up	9.4	7.4	4.5	0.8	0.7	0.4	....
Red oak	4″–9″	....	....	....	.....			
	10″ up	4.0	3.2	1.9	....	....	....	....
Poplar	4″–9″	25.6	20.2	12.2	342.4	269.9	164.2	95.2
	10″ up	107.7	85.1	51.2	246.9	194.6	118.5	216.9
Black ash	4″–9″	61.0	48.2	29.0	51.8	40.9	24.8	62.2
	10″ up	44.0	34.8	20.9	2.0	1.6	1.0	12.0
White ash	4″–9″	10.0	7.9	4.8	20.2	15.9	9.7	8.3
	10″ up	26.4	20.8	12.5	71.3	56.2	34.2	16.3
Basswood	4″–9″	11.8	9.3	5.6	6.4	5.0	3.1	38.6
	10″ up	44.8	35.3	21.3	7.1	5.6	3.5	142.2
Black cherry	4″–9″	11.4	9.0	5.4	7.3	5.8	3.5	8.0
	10″ up	37.1	29.3	17.6	8.9	6.9	4.2	5.2
Hickory	4″–9″							3.1
	10″ up	4.0	3.2	1.9				
TOTAL HARDWOODS	4″–9″	463.9	366.4	220.4	867.0	683.4	415.9	538.1
	10″ up	2356.0	1860.9	1119.8	855.3	674.2	410.4	1422.0
GRAND TOTAL	4″–9″	901.1	711.7	428.1	1579.1	1244.6	757.3	869.4
	10″ up	3138.9	2479.3	1491.9	1111.9	876.4	533.7	1766.9
TOTAL 4″ UP		4040.0	3191.0	1920.0	2691.0	2121.0	1291.0	2636.3

Table 18. — *Volume of the primary growing stock in cubic feet per acre.*
Niagara Section — 1957

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	18.7	15.9	9.9	9.8	7.8	4.6	....
	10″ up	120.7	102.8	64.3	159.4	126.0	75.5	....
White spruce	4″–9″	3.0	2.5	1.6	68.0	53.8	32.2	....
	10″ up	13.2	11.3	7.0	34.6	27.3	16.4	....
Black spruce	4″–9″	....	....	....	16.6	13.2	7.9	....
	10″ up	....	....	....	....	....	....	....
Balsam fir	4″–9″	35.0	29.8	18.6	208.2	164.7	98.6	....
	10″ up	20.1	17.1	10.7	24.7	19.5	11.7	....
Hemlock	4″–9″	127.8	108.8	68.0	11.5	9.1	5.4	....
	10″ up	361.7	307.9	192.5	38.4	30.4	18.2	....
White cedar	4″–9″	682.1	580.7	362.9	1039.6	822.2	492.2	....
	10″ up	861.1	733.0	458.2	205.5	162.5	97.3	....
Larch	4″–9″	0.7	0.6	0.4	61.0	48.3	28.9	....
	10″ up	5.8	4.9	3.1	....	....	....	....
Total Conifers	4″–9″	867.3	738.3	461.4	1414.7	1119.1	669.8	....
	10″ up	1382.6	1177.0	735.8	462.6	365.7	219.1	....
Sugar maple	4″–9″	10.2	8.7	5.4	1.7	1.4	0.8	....
	10″ up	151.9	129.3	80.9	20.5	16.1	9.7	....
Soft maple	4″–9″	8.7	7.4	4.6	11.2	8.8	5.3	....
	10″ up	46.4	39.5	24.7	....	....	....	....
White birch	4″–9″	16.5	14.0	8.8	104.7	82.8	49.6	....
	10″ up	19.2	16.4	10.2	67.2	53.2	31.8	....
Yellow birch	4″–9″	35.3	30.1	18.8	44.1	34.9	20.9	....
	10″ up	120.3	102.4	64.0	50.2	39.7	23.7	....
Beech	4″–9″	4.9	4.2	2.6	....	....	....	....
	10″ up	131.3	111.7	69.9	27.7	21.9	13.1	....
Elm	4″–9″	15.4	13.1	8.2	53.7	42.4	25.4	....
	10″ up	221.3	188.4	117.7	170.9	135.2	81.0	....
Ironwood	4″–9″	7.1	6.1	3.8	....	....	....	....
	10″ up	9.1	7.7	4.8	....	....	....	....
Red oak	4″–9″	....	....	....	....	....	....	....
	10″ up	6.5	5.5	3.4	....	....	....	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar	4″–9″	13.0	11.0	6.9	163.0	128.9	77.2	....
	10″ up	61.6	52.5	32.8	167.0	132.0	79.1	....
Black ash	4″–9″	12.0	10.2	6.4	1.9	1.5	0.9	....
	10″ up	4.2	3.6	2.2	3.6	2.8	1.7	....
White ash	4″–9″	0.9	0.8	0.5	....	....	....	....
	10″ up	5.6	4.7	3.0	....	....	....	....
Basswood	4″–9″	3.2	2.7	1.7	....	....	....	....
	10″ up	81.1	69.1	43.1	....	....	....	....
Black cherry	4″–9″	0.2	0.2	0.1	3.2	2.6	1.5	....
	10″ up	3.0	2.6	1.6	5.1	4.0	2.4	....
Total Hardwoods	4″–9″	127.4	108.5	67.8	383.5	303.3	181.6	....
	10″ up	864.7	736.2	460.0	512.2	404.9	242.5	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1798.2	1422.4	851.4	....
	10″ up	2247.3	1913.2	1195.8	974.8	770.6	461.6	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2773.0	2193.0	1313.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	....	....	....	2.3	1.8	1.1	5.0
	10″ up	....	....	....	9.4	7.4	4.4	14.7
Total Conifers	4″–9″	....	....	....	2.3	1.8	1.1	5.0
	10″ up	....	....	....	9.4	7.4	4.4	14.7

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	88.7	69.8	41.7	96.4	76.3	45.4	104.3
	10″ up	406.7	320.1	191.3	60.4	47.7	28.4	183.8
Soft maple	4″–9″	103.2	81.2	48.5	168.6	133.5	79.4	137.8
	10″ up	763.7	601.1	359.3	147.2	116.4	69.2	325.7
White birch	4″–9″	....	....	....	10.2	8.0	4.8	....
	10″ up	....	....	....	1.5	1.2	0.7	....
Yellow birch	4″–9″	9.7	7.6	4.6	18.4	14.6	8.7	14.1
	10″ up	15.1	11.9	7.1	7.3	5.8	3.4	14.2
Beech	4″–9″	54.1	42.6	25.4	75.4	59.6	35.5	59.3
	10″ up	292.6	230.3	137.7	86.1	68.0	40.5	143.1
Elm	4″–9″	198.9	156.6	93.6	310.6	245.6	146.1	205.9
	10″ up	1101.3	866.8	518.1	325.9	257.6	153.3	559.2
Ironwood	4″–9″	21.3	16.8	10.1	29.1	22.9	13.7	22.8
	10″ up	3.5	2.7	1.6	1.3	1.1	0.6	3.7
Red oak	4″–9″	17.6	13.8	8.3	75.0	59.3	35.3	38.7
	10″ up	139.3	109.7	65.5	77.1	60.9	36.3	122.9
White oak	4″–9″	35.7	28.1	16.8	64.8	51.2	30.5	48.0
	10″ up	141.8	111.6	66.7	68.6	54.2	32.3	104.1
Poplar	4″–9″	27.5	21.6	12.9	102.4	80.9	48.2	18.1
	10″ up	71.6	56.4	33.7	49.7	39.3	23.4	25.8
Black ash	4″–9″	13.0	10.2	6.1	27.5	21.7	12.9	13.5
	10″ up	7.6	6.0	3.6	5.3	4.2	2.5	9.3
White ash	4″–9″	75.9	59.8	35.7	133.9	105.8	63.0	69.0
	10″ up	217.2	170.9	102.2	90.7	71.8	42.7	141.0
Basswood	4″–9″	28.3	22.2	13.3	45.2	35.7	21.2	20.6
	10″ up	145.1	114.3	68.3	55.4	43.9	26.1	77.3
Black cherry	4″–9″	12.6	9.9	5.9	32.2	25.4	15.1	17.0
	10″ up	32.8	25.8	15.4	24.0	19.0	11.3	27.8
Butternut	4″–9″	....	....	....	....	....	....	3.2
	10″ up	....	....	....	....	....	....	8.3
Hickory	4″–9″	47.8	37.6	22.5	98.6	78.0	46.4	48.4
	10″ up	55.4	43.6	26.1	39.5	31.2	18.6	45.9
TOTAL HARDWOODS	4″–9″	734.3	577.8	345.4	1288.3	1018.5	606.2	820.7
	10″ up	3393.7	2671.2	1596.6	1040.0	822.3	489.3	1792.1
GRAND TOTAL	4″–9″	734.3	577.8	345.4	1290.6	1020.3	607.3	825.7
	10″ up	3393.7	2671.2	1596.6	1049.4	829.7	493.7	1806.8
TOTAL 4″ UP		4128.0	3249.0	1942.0	2340.0	1850.0	1101.0	2632.5
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	60.7	48.1	28.7	78.2	62.1	37.7	103.4
	10″ up	670.5	531.1	317.3	90.6	72.1	43.7	382.5
Red pine	4″–9″							77.1
	10″ up	....	....	....	....	....	....	134.0
Balsam fir	4″–9″	....	....	....	2.7	2.1	1.3	.....
	10″ up	....	....	....	....	....		
Hemlock	4″–9″	148.5	117.7	70.3	42.4	33.7	20.4	61.5
	10″ up	257.3	203.8	121.7	80.9	64.3	39.0	162.2
White cedar	4″–9″	113.9	90.2	53.9	351.2	279.1	169.3	95.0
	10″ up	142.0	112.5	67.2	80.3	63.8	38.7	42.1
Larch	4″–9″	4.2	3.3	2.0	58.2	46.2	28.1	
	10″ up	3.1	2.5	1.5	24.9	19.8	12.0	
TOTAL CONIFERS	4″–9″	327.3	259.3	154.9	532.7	423.2	256.8	337.0
	10″ up	1072.9	849.9	507.7	276.7	220.0	133.4	720.8
Sugar maple	4″–9″	25.6	20.2	12.1	8.0	6.4	3.9	76.7
	10″ up	142.6	113.0	67.5	....	....	....	81.0
Soft maple	4″–9″	105.7	83.7	50.0	162.1	128.9	78.1	109.0
	10″ up	150.2	119.0	71.1	213.1	169.4	102.8	151.4

Table 18 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*)			MIXEDWOODS IMMATURE (M-II) (*Cont'd*)			MIXEDWOODS ALL-AGED (*Cont'd*)
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White birch	4″–9″	7.5	6.0	3.5	114.2	90.8	55.1	35.1
	10″ up	18.1	14.3	8.6	17.1	13.6	8.2	18.0
Yellow birch	4″–9″	87.4	69.2	41.4	127.2	101.1	61.3	41.6
	10″ up	106.4	84.3	50.3	47.0	37.4	22.7	24.4
Beech	4″–9″	49.0	38.8	23.2	4.0	3.2	1.9	22.7
	10″ up	327.6	259.4	155.0	14.8	11.7	7.1	158.3
Elm	4″–9″	54.9	43.5	26.0	192.0	152.5	92.5	96.4
	10″ up	467.9	370.6	221.3	435.1	345.9	209.8	351.3
Ironwood	4″–9″	3.7	2.9	1.7	....	....	....	11.0
	10″ up	....	....	....	....	....	....	....
Red oak	4″–9″	6.6	5.2	3.1	14.6	11.6	7.0	63.2
	10″ up	198.1	157.0	93.8	6.8	5.4	3.3	167.5
White oak	4″–9″	51.9	41.1	24.5	20.5	16.3	9.9	84.8
	10″ up	251.6	199.2	119.0	6.3	5.0	3.0	26.5
Poplar	4″–9″	10.4	8.2	4.9	218.0	173.3	105.1	18.1
	10″ up	37.1	29.5	17.6	133.1	105.7	64.2	29.7
Black ash	4″–9″	21.7	17.2	10.3	67.7	53.8	32.7	29.3
	10″ up	11.2	8.9	5.3	7.3	5.8	3.5	2.1
White ash	4″–9″	3.4	2.7	1.6	5.4	4.3	2.6	11.3
	10″ up	18.5	14.7	8.8	....	....	....	16.9
Basswood	4″–9″	6.9	5.5	3.3	14.0	11.1	6.7	13.1
	10″ up	26.0	20.6	12.3	12.8	10.2	6.2	45.6
Black cherry	4″–9″	14.5	11.5	6.9	24.1	19.1	11.6	6.9
	10″ up	51.3	40.6	24.3	5.4	14.3	2.6	26.6
Butternut	4″–9″	....	....	....	....	....	....	0.6
	10″ up	....	....	....	....	....	....	11.1
Hickory	4″–9″	....	....	....	....	....	....	9.0
	10″ up	....	....	....	....	....	....	9.3
Total Hardwoods	4″–9″	449.2	355.7	212.5	971.8	772.4	468.4	628.8
	10″ up	1806.6	1431.1	854.9	898.8	714.4	433.4	1119.7
GRAND TOTAL	4″–9″	776.5	615.0	367.4	1504.5	1195.6	725.2	965.8
	10″ up	2879.5	2281.0	1362.6	1175.5	934.4	566.8	1840.5
TOTAL 4″ UP		3656.0	2896.0	1730.0	2680.0	2130.0	1292.0	2806.3

County Forests established on these areas results in improved land use through reforestation.

Common and Botanical Names of Tree Species
Included in Timber Estimates

CONIFERS

White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Jack pine	*Pinus Banksiana Lamb.*
Scots pine	*Pinus sylvestris L.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Norway spruce	*Picea abies (L.) Karst.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Eastern larch	*Larix laricina (Du Roi) K. Koch*
European larch	*Larix decidua Mill.*

HARDWOODS

Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.*
	Acer saccharinum L.
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.*
	Ulmus rubra Muhl.
	Ulmus Thomasi Sarg.
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.*
	Quercus palustris Muenchh.
	Quercus velutina Lam.
White oak	*Quercus alba L.*
	Quercus macrocarpa Michx.
	Quercus bicolor Willd.
	Quercus Muehlenbergii Engelm.
	Quercus prinoides Willd.
Poplar	*Populus tremuloides Michx.*
	Populus balsamifera L.
	Populus grandidentata Michx.
	Populus deltoides Marsh.
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.*
	Fraxinus pennsylvanica Marsh.
	Var. subintegerrima (Vahl) Fern.
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Walnut	*Juglans nigra L.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch*
	Carya cordiformis (Wang) K. Koch
	Carya tomentosa Nutt.
	Carya glabra (Mill.)

Notes

Hon. J. W. Spooner
Minister

F. A. MacDougall
Deputy Minister

Report No. 22 of the

LAKE ERIE DISTRICT

Forest Resources Inventory

— 1958 —

Division of Timber

Ontario Department of Lands and Forests

Forest Resources Inventory

— 1958 —

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LAKE ERIE DISTRICT

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Ontario Department of Lands and Forests

PREFACE

• A large proportion of the earth's land area is covered by forests, which exert an influence, largely beneficial, upon the lives of human beings. Forests reduce soil erosion, regulate stream flow, are a habitat for game, and provide opportunities for recreation. Their prime importance to man, however, is in the production of wood, upon which a wide variety of important industries is based.

Wood, because of its wide distribution and the diverse uses to which it is put, is sometimes known as "the universal raw material." Throughout recorded history, it has been one of our chief sources of fuel. A large proportion is utilized in the construction of buildings of all kinds. Toothpicks, excelsior, shingles, veneer, plywood, boxes and crates are a few of the wide variety of articles produced from wood. Modern adhesives have expanded the use of wood in laminated construction. Chemical utilization has yielded newsprint, writing paper, cartons, paper board, cellophane, rayon and plastics, while even more spectacular advances may lie ahead. Wood distillation produces charcoal, and a residual material which through further processing, can be converted into acetic acid, acetic anhydride, acetone, sodium acetate, methyl alcohol and formaldehyde.

Forests, despite their many benefits and a constantly increasing demand for their products, are being continually destroyed. When it becomes apparent that the forest resource is being depleted, with critical effects upon the supply of products and services, the need for conservation is recognized. Fortunately, forests are renewable, although their restoration may require a considerable period of time. Since 1946, the Department of Lands and Forests has been engaged in a province-wide survey to determine the present status of our forest resources.

The extension of this survey to include the southern agricultural areas was authorized in 1952, and work was started by the Division of Timber early in 1953. Since April 1, 1951, the Federal Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in forest resources inventory, under the terms of an agreement pursuant to the provisions of the Canada Forestry Act.

For purposes of administration of the renewable natural resources, the Depart. ment of Lands and Forests has established twenty-two districts, each administered by a District Forester and staff, from an office located centrally in the district. The forest resources inventory covers these twenty-two districts, totalling 199,000 square miles, and comprising the accessible forest area of Ontario. This report, the twenty-second in the series, deals with the results of the inventory in the Lake Erie district.

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FIGURES

SURVEY HIGHLIGHTS

1. The total area of the Lake Erie district, excluding 80,172 acres administered by the Federal Government, is 4,126,774 acres, or 6,448 square miles.

2. Inland waters, excluding the "Great Lakes," cover only 57,240 acres, or one per cent of the total area.

3. The total land area of the district, including Federal lands, is 4,149,706 acres. Forested land accounts for 10.3 per cent, agricultural land for 82.1 per cent and other areas, including Federal lands, municipalities, railways, roads, for 7.6 per cent.

4. Ninety-eight per cent of the area of the district is classed as patented land. The areas of Crown land, comprising two per cent of the district, include, for the purposes of this report, all areas administered under an agreement with the Minister of Lands and Forests.

5. Productive forest land, totalling 321,224 acres, is classed as 20 per cent mature, 40 per cent immature, 23 per cent all-aged, 13 per cent young growth and 4 per cent reproducing forest.

6. The district is essentially an area of deciduous forest and has 92 per cent of the productive forest land in the hardwood cover type. The coniferous and mixedwoods type each cover 4 per cent of the area.

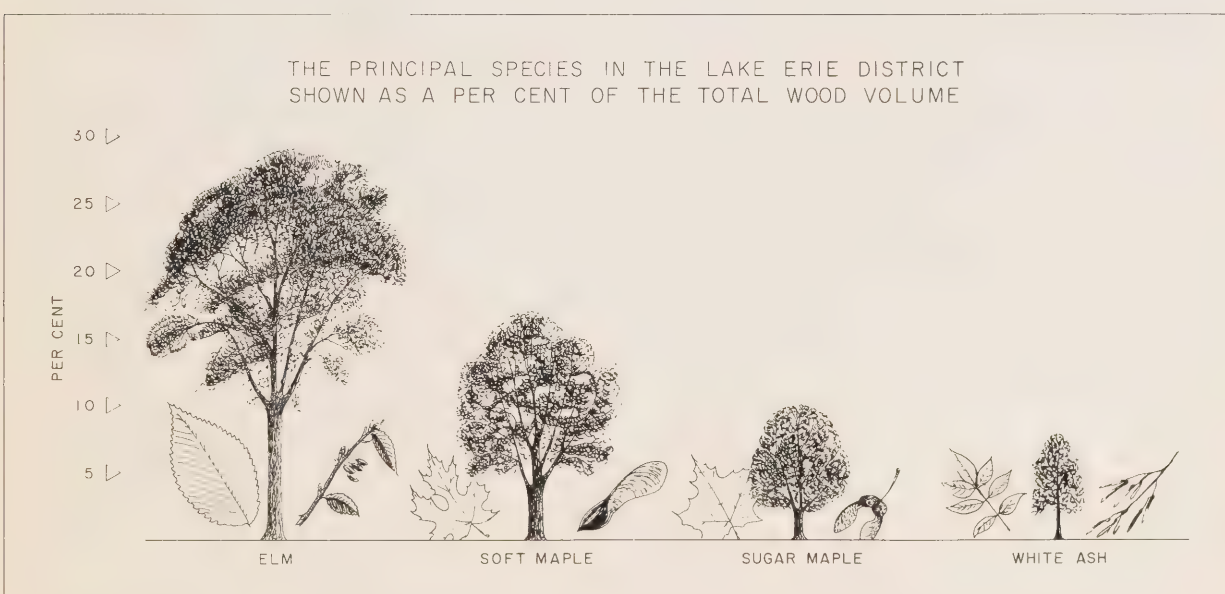
7. The primary growing stock in the Lake Erie district is just over 596 million cubic feet and averages 1,857 cubic feet per acre. Hardwoods form 98 per cent of the total volume. Of the total wood volume in the district, 97 per cent occurs on patented lands.

8. The principal species in the district is elm, which forms 29 per cent of the total growing stock. It is followed by soft maple with 17 per cent and sugar maple with 10 per cent of the volume.

9. On patented lands, the 4 to 9-inch size class contains 36 per cent of the volume and the 10-inch and over size class contains 64 per cent of the volume.

10. The annual allowable cut permissible under management is 14.6 million cubic feet. Hardwood species make up 99 per cent of the allowable cut.

11. Elm, which totals nearly 172 million cubic feet, is subjected to a serious attack of the Dutch Elm disease, and the volume of elm in the district is expected to be greatly reduced.



MAP
OF
THE PROVINCE OF ONTARIO
SHOWING
ADMINISTRATIVE DISTRICTS
OF THE
DEPARTMENT OF LANDS AND FORESTS

SCALE OF MILES
30 20 10 0 35 70 105

Forest resources inventory photograph of the Town of Aylmer, taken with a six-inch focal length aerial camera from an altitude of 7,920 feet. Scale of photograph: 4 inches to the mile.

FOREST INVENTORY

Historical Background

• Loyalists from the American settlements were attracted to the Lake Erie shore, and thus the region was settled at an early date. It was, however, a long time before any but a local market developed for wood, and much of the timber was burned in the course of clearing the land for agriculture.

High-quality products such as square pine and oak, and oak staves were shipped to the Quebec market for export upon completion of the Welland Canal. Sawmilling increased with the opening of the American market, and by 1848 there were 525 sawmills tributary to the lake front. By 1850, the Lake Erie counties were the largest lumber producers in Upper Canada; they were shipping to Buffalo and Cleveland.

It is on record that the best and largest white pine came from this region, and that the light sandy soils of the counties of Haldimand, Norfolk, Brant and Elgin produced pine of a quality never exceeded by any other section on the continent. When the pine was removed, much of the soil was found to be too light to sustain agriculture. In addition, the lake ports, which were dependent upon lumber shipments, continued as fishing villages, but were replaced as shipping ports by settlements back from the lakes upon completion of the railways.

Settlement back from the lake, except for isolated instances, was delayed until after 1820, and the western region around Lake St. Clair was further handicapped by remoteness and the necessity for drainage. As late as 1845, there was little demand for pine logs from this inland area. Much of the area was covered by hardwoods which were of little interest to the lumbermen. These areas were arduously cleared for agriculture, for which they were better suited than the more easily cleared pine lands.

When the construction of roads made penetration of the area possible, it was rapidly settled. The fertile soil and favourable climate make this region well-suited for agriculture. In later years, the proximity of the area to power, transportation and markets has led to rapid industrialization and a large urban population. The natural result of this development has been a marked reduction in the forested area and its restriction to the less favourable sites.

During the period 1900–1925, much of the light soil which was found to be unsuitable for agriculture was abandoned, and the rural population in these areas declined. In 1928, Norfolk County was the first county in Ontario to have a soil survey made. It was completed in time to guide the selection of suitable soil for tobacco growing. The success of tobacco farming brought about considerable resettlement of the abandoned light soils.

Within the district are two parks unique for their flora and fauna which is of a southern type, dense and luxurious. The Rondeau Provincial Park, of 8.6 square miles, was established in 1894. It contains almost the last natural stand of southern hardwoods in Ontario. The Point Pelee National Park was established in 1918 and covers 6 square miles. Besides the southern trees it contains cactus plants, prickly pear and wild grapes. Such southern birds as the Carolina wren, cardinal, cerulean warbler and blue-gray gnatcatcher are found here.

White elm tree showing early stages of attack by the Dutch Elm disease.

Areas

The total area of the Lake Erie district, excluding Indian Reserve lands and other areas under the administration of the Federal Government, is 4,126,774 acres (table 1), 6,448 square miles. This area is surveyed into 91 townships, which comprise 9 counties. Within the district, inland waters, excluding the "Great Lakes," cover only 57,240 acres, or one per cent of the total area. Productive forest lands occupy 321,224 acres, or 8 per cent of the total area (fig. 1).

TABLE 1. — *Total area classification into broad land and ownership groups.*

Land classification	Crown land	Patented land	Total
	acres	*acres*	*acres*
Productive forest land[1]	10,602	310,622	321,224
Non-forested land[2]			
Developed agricultural land	270	2,904,146	2,904,416
Grass and meadow land	274	342,796	343,070
Non-reproducing burn	....	....	......
Wooded pasture	462	158,344	158,806
Unclassified land[3]	2,084	232,310	234,394
TOTAL	3,090	3,637,596	3,640,686
Non-productive forest[4]			
Open muskeg	1,050	33,054	34,104
Treed muskeg (scrub)	....	112	112
Brush, alder, and flooded land	1,220	71,322	72,542
Rock outcrop	....	866	866
TOTAL	2,270	105,354	107,624
Water	57,240	....	57,240
TOTAL AREA	73,202	4,053,572	4,126,774

[1] Land bearing or capable of bearing timber of a commercial character and not withdrawn from such use.
[2] Productive forest lands permanently withdrawn from timber production use.
[3] Lands occupied by roads, railroads, towns, etc.
[4] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity.

Non-productive forest lands, which appear to be permanently unfit for commercial timber production due to very low productivity, occupy 107,624 acres, or 3 per cent of the total area. Non-forested lands, which include areas permanently withdrawn from timber production, total 3,640,686 acres, or about 88 per cent of the total area. Within this classification, developed agricultural land comprises 2,904,416 acres (fig. 2), nearly 80 per cent of the non-forested area. Grass and meadow occupy 343,070 acres. Areas of low-density stands (often comprised of a few large open-grown trees with wide-spreading crowns) that are quite heavily grazed have been classified as wooded pasture. These total 158,806 acres. In addition, there are 234,394 acres of unclassified land occupied by cities, towns, villages, roads, railways, power lines, gravel-pits or otherwise withdrawn from forest production.

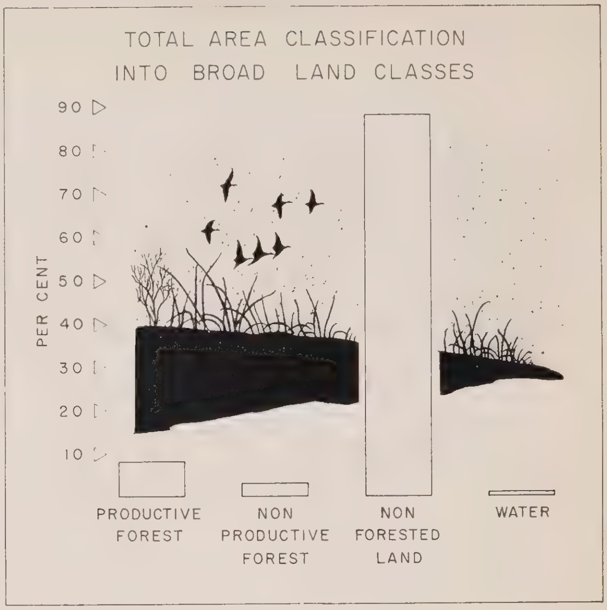


FIGURE 1

The principal land classifications by townships

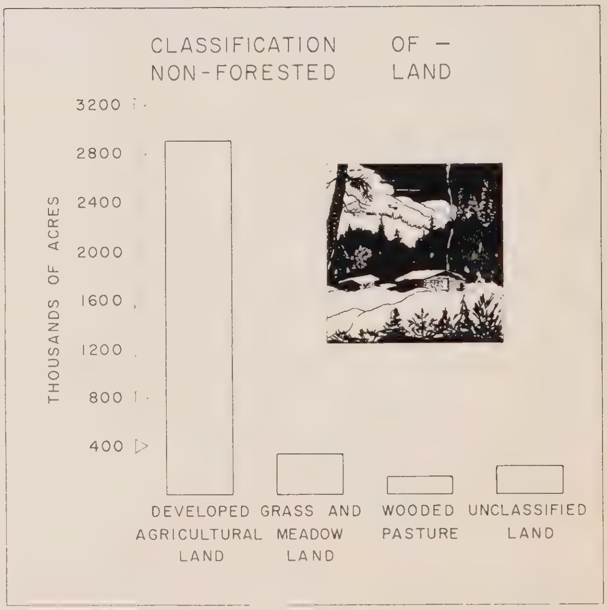


FIGURE 2

and counties (table 2) indicate that Norfolk County, with 15.1 per cent of the land area classed as productive forest and 5.5 per cent as non-productive forest, is the most heavily forested county within the district. It is followed by Lambton County with 9.2 per cent productive forest and 3.4 per cent non-productive forest, and Elgin County with 10.1 per cent productive forest and 0.9 per cent non-productive forest. Essex County, with a forested area of only 4 per cent, almost evenly divided between productive and non-productive land, has the smallest forested area in the district.

An analysis of productive forest land by townships (fig. 3) indicates that the principal forested areas occur in four distinct sections in the district. Bosanquet and West Williams Townships in the north-west corner of the district have 16.8 and 10.9 per cent, respectively, classified as productive forest land. Three townships in the eastern part of the district, Caister, Canborough and South Cayuga, have 10.8, 13.6 and 11.8 per cent of the area classed as productive forest land. Five townships which are located mainly on the Bothwell Sand Plain have the following percentages devoted to productive forest land: Mosa 18.2 per cent, Zone 15.4 per cent, Euphemia 14.0 per cent, Aldborough 12.9 per cent, and Dunwich 10.6 per cent. The greatest areas of productive forest land occur on 8 townships in Norfolk and Elgin Counties. These are located on the Norfolk Sand Plain. Charlotteville Township has 28.7 per cent of the land area classified as productive forest land. This classification includes 18.4 per cent of Houghton, 16.8 per cent of South Walsingham, 15.0 per cent each of Bayham and North Walsingham, 13.5 per cent of Middleton, 13.1 per cent of Windham and 11.2 per cent of Malahide.

Developed agricultural land ranges from 61.0 per cent of the land area in Lambton County to 83.1 per cent in Kent County. Areas classed as grass and meadow vary from a low of 1.8 per cent in Essex County to a high of 17.7 per cent in Middlesex County. Wooded pasture, which covers only 3.8 per cent of the land area in the district, forms between 1.7 and 6.5 per cent of the area by counties. Other areas, which include Federal Lands, form 3.7 per cent of Elgin County and 15.1 per cent of Welland County. Included in this classification is Walpole Island, an area of 38,368 acres in Lambton County that is totally Indian Reserve land.

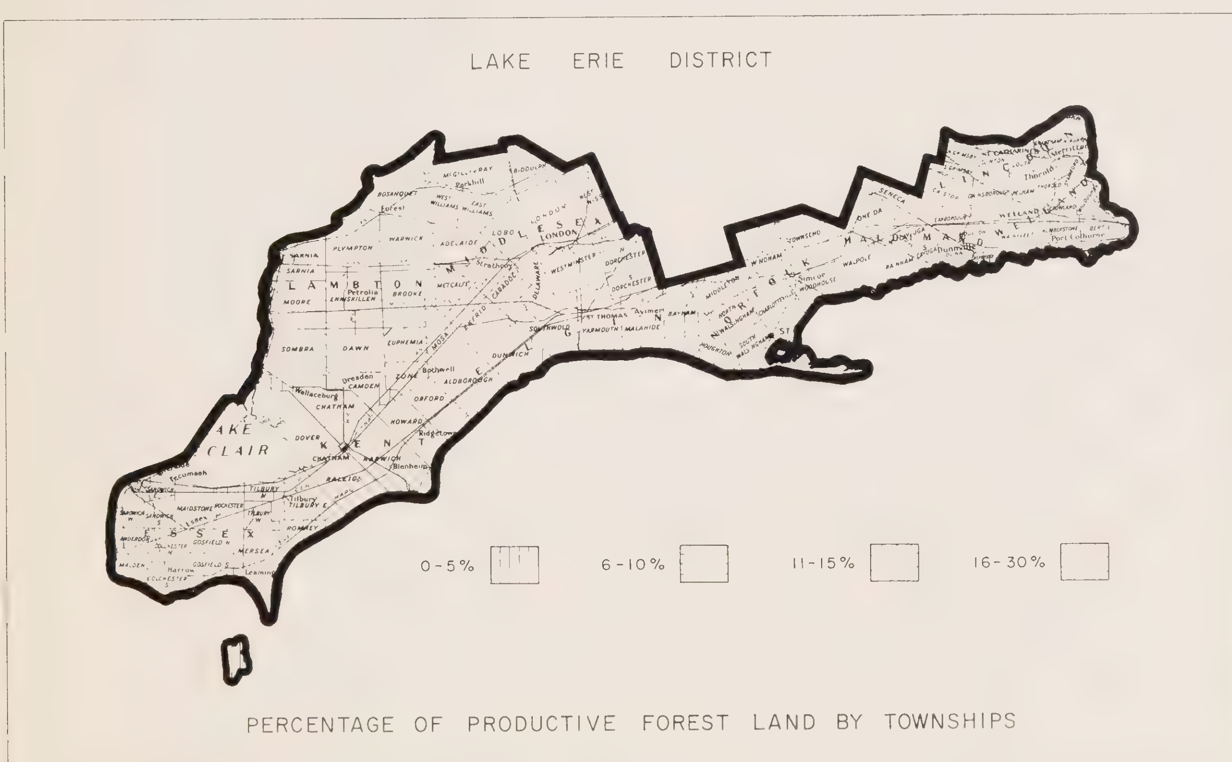


Figure 3

TABLE 2. — *Principal land classifications by townships and counties — Lake Erie district.*

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas[1]	
	acres	*acres*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Aldborough	78,094	77,112	9,944	12.9	1,740	2.3	52,340	67.9	9,120	11.8	2,132	2.7	1,836	2.4
Bayham	59,230	58,698	8,798	15.0	332	0.6	40,690	69.3	1,466	2.5	5,772	9.8	1,640	2.8
Dunwich	71,338	70,192	7,454	10.6	962	1.4	46,532	66.3	8,590	12.2	4,740	6.8	1,914	2.7
Malahide	64,238	63,720	7,122	11.2	482	0.8	48,432	76.0	1,844	2.9	3,512	5.5	2,328	3.6
South Dorchester	31,960	31,612	1,590	5.0	52	0.2	27,216	86.1	930	2.9	1,202	3.8	622	2.0
Southwold	75,324	74,430	5,278	7.1	128	0.2	53,396	71.7	6,472	8.7	6,540	8.8	2,616	3.5
Yarmouth	72,918	71,674	5,164	7.2	324	0.5	52,140	72.7	3,156	4.4	5,512	7.7	5,378	7.5
ELGIN COUNTY	453,102	447,438	45,350	10.1	4,020	0.9	320,746	71.7	31,578	7.1	29,410	6.5	16,334	3.7
Anderdon	24,252	23,628	542	2.3	1,112	4.7	18,720	79.2	982	4.2	568	2.4	1,704	7.2
Colchester North	32,052	31,910	1,078	3.4	122	0.4	28,346	88.8	548	1.7	490	1.5	1,326	4.2
Colchester South	35,334	35,004	1,660	4.7	398	1.1	29,328	83.8	812	2.3	830	2.4	1,976	5.7
Gosfield North	28,816	28,678	338	1.2	36	0.1	26,672	93.0	260	0.9	356	1.2	1,016	3.6
Gosfield South	31,362	30,938	1,132	3.7	180	0.6	26,042	84.2	638	2.1	510	1.5	2,436	7.9
Maidstone	46,306	46,000	1,204	2.6	332	0.7	39,686	86.3	606	1.3	868	1.9	3,304	7.2
Malden	21,980	21,108	424	2.0	1,374	6.5	17,188	81.4	472	2.3	212	1.0	1,438	6.8
Morsea	64,676	63,830	1,884	3.0	1,400	2.2	51,664	80.9	1,190	1.9	714	1.1	6,978	10.9
Pelee Island	10,526	10,456	558	5.3	570	5.5	8,060	77.1	322	3.1	462	4.4	484	4.6
Rochester	33,764	33,424	456	1.4	176	0.5	30,044	89.9	530	1.5	494	1.5	1,724	5.2
Sandwich East	21,460	21,306	168	0.8	142	0.7	10,668	50.1	212	1.0	164	0.7	9,952	46.7
Sandwich South	24,200	24,012	466	1.9	298	1.3	20,258	84.4	556	2.3	318	1.3	2,116	8.8
Sandwich West	26,860	26,350	390	1.5	482	1.8	12,110	46.0	390	1.5	886	3.3	12,092	45.9
Tilbury North	27,230	26,934	214	0.8	620	2.3	24,368	90.5	280	1.0	204	0.8	1,248	4.6
Tilbury West	23,238	23,118	342	1.4	60	0.3	20,798	90.0	376	1.6	508	2.2	1,034	4.5
ESSEX COUNTY	452,056	446,696	10,856	2.4	7,302	1.6	363,952	81.5	8,174	1.8	7,584	1.7	48,828	11.0
Canborough	22,416	21,942	3,010	13.6	674	3.1	16,164	73.7	718	3.3	738	3.4	638	2.9
Dunn	17,162	16,094	1,400	8.7	650	4.0	11,852	73.6	810	5.0	626	4.0	756	4.7
Moulton	30,108	29,502	3,018	10.2	1,132	3.8	21,592	73.2	1,314	4.5	940	3.2	1,506	5.1
North Cayuga	35,272	34,546	3,306	9.6	1,030	3.0	26,496	76.7	1,210	3.5	1,048	3.0	1,456	4.2
Oneida	42,592	41,992	2,338	5.6	334	0.8	27,580	65.7	1,324	3.2	892	2.0	9,524	22.7
Rainham	26,052	25,710	1,812	7.0	166	0.6	21,654	84.2	502	2.0	734	2.9	842	3.3
Seneca	43,856	43,248	3,414	7.9	1,592	3.7	34,026	78.7	2,120	4.8	758	1.8	1,338	3.1
Sherbrooke	5,164	5,102	276	5.4	160	3.2	3,936	77.1	214	4.2	172	3.4	344	6.7
South Cayuga	14,990	14,658	1,734	11.8	276	1.9	11,444	78.1	438	3.0	320	2.2	446	3.0
Walpole	70,194	69,260	2,900	4.2	266	0.4	58,682	84.7	2,272	3.3	1,746	2.5	3,394	4.9
HALDIMAND COUNTY	307,806	302,054	23,208	7.7	6,280	2.1	233,426	77.3	10,922	3.6	7,974	2.6	20,244	6.7
Camden	43,766	43,140	2,300	5.3	758	1.8	34,644	80.3	2,158	5.0	1,540	3.6	1,740	4.0
Chatham	91,386	89,836	2,042	2.3	612	0.7	80,770	89.9	1,228	1.3	1,402	1.6	3,782	4.2
Dover	71,502	70,016	434	0.6	6,640	9.5	60,572	86.5	140	0.2	276	0.4	1,954	2.8
Harwich	98,216	95,356	4,164	4.4	2,204	2.3	77,820	81.6	4,120	4.3	1,304	1.4	5,744	6.0
Howard	60,688	59,880	2,696	4.5	1,010	1.7	49,086	82.0	3,510	5.9	1,678	2.8	1,900	3.1
Orford	53,706	53,038	5,130	9.7	1,370	2.6	36,614	69.0	4,620	8.7	1,236	2.3	4,068	7.7
Raleigh	74,602	73,558	1,466	2.0	788	1.1	63,938	86.9	3,318	4.5	706	1.0	3,342	4.5
Romney	26,820	26,608	1,126	4.2	90	0.3	23,162	87.1	656	2.5	490	1.8	1,084	4.1
Tilbury East	56,666	56,022	792	1.4	662	1.2	51,292	91.6	778	1.4	612	1.1	1,886	3.3
Zone	27,574	26,920	4,156	15.4	1,758	6.5	15,960	59.3	2,940	10.9	1,094	4.1	1,012	3.8
KENT COUNTY	604,926	594,374	24,306	4.1	15,892	2.7	493,858	83.1	23,468	3.9	10,338	1.7	26,512	4.5
Bosanquet	79,294	78,074	13,132	16.8	4,126	5.3	46,508	59.6	3,948	5.1	2,882	3.7	7,478	9.5
Brooke	74,966	74,168	6,552	8.8	1,698	2.3	48,390	65.3	13,594	18.3	2,268	3.1	1,666	2.2
Dawn	68,098	67,490	4,974	7.4	450	0.7	47,568	70.5	9,268	13.7	3,676	5.4	1,554	2.3
Enniskillen	87,596	86,792	7,212	8.3	4,080	4.7	58,548	67.4	9,508	11.0	3,032	3.5	4,412	5.1
Euphemia	40,136	39,310	5,498	14.0	1,250	3.2	24,576	62.5	5,770	14.7	1,142	2.9	1,074	2.7
Moore	73,286	72,912	7,342	10.1	4,972	6.8	43,016	59.0	12,040	16.5	2,906	4.0	2,636	3.6
Plympton	78,578	78,032	6,642	8.5	2,110	2.7	53,720	68.8	10,624	13.6	2,530	3.3	2,406	3.1

TABLE 2. — (*Cont'd*)

Township and county	Total area	Total land area	Forested land: Productive		Forested land: Non-productive		Agricultural land: Developed agricultural land		Agricultural land: Grass and meadow		Agricultural land: Wooded pasture		Other areas[1]	
	acres	acres	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent	acres	per cent
Sarnia	48,404	48,030	1,860	3.9	1,584	3.3	25,072	52.2	4,192	8.7	1,100	2.3	14,222	29.6
Sombra	72,962	72,278	5,892	8.1	1,652	2.3	47,118	65.2	12,706	17.6	3,098	4.3	1,812	2.5
Walpole Island	38,368	38,368	....	....	....	....	....	....	....	....	....	....	38,368	100.0
Warwick	71,616	70,740	7,196	10.2	2,432	3.4	46,150	65.2	11,392	16.1	1,666	2.4	1,904	2.7
LAMBTON COUNTY	733,304	726,194	66,300	9.2	24,354	3.4	440,666	61.0	93,042	12.8	24,300	3.4	77,532	10.2
Caister	33,898	33,510	3,610	10.8	692	2.0	26,464	79.0	874	2.6	1,198	3.6	672	2.0
Clinton	26,722	26,528	2,044	7.7	140	0.5	21,748	82.0	510	1.9	582	2.2	1,504	5.7
Gainsborough	25,170	24,754	1,994	8.1	292	1.2	20,832	84.1	516	2.1	418	1.7	702	2.8
Grantham	24,132	22,652	504	2.2	184	0.8	11,404	50.3	470	2.1	202	0.9	9,888	43.7
Louth	20,116	19,208	1,320	6.9	250	1.3	14,994	78.1	788	4.1	678	3.5	1,178	6.1
Niagara	24,626	23,532	940	4.0	178	0.8	18,334	77.9	226	1.0	414	1.7	3,440	14.6
North Grimsby	16,918	16,848	1,712	10.2	100	0.6	12,888	76.5	216	1.3	272	1.6	1,660	9.8
South Grimsby	18,996	18,864	1,242	6.6	50	0.3	16,108	85.4	300	1.6	454	2.4	710	3.7
LINCOLN COUNTY	190,578	185,896	13,366	7.2	1,886	1.0	142,772	76.8	3,900	2.1	4,218	2.3	19,754	10.6
Adelaide	46,034	45,336	2,400	5.3	1,370	3.0	24,308	53.6	13,524	29.9	2,184	4.8	1,550	3.4
Biddulph	41,372	41,284	924	2.2	156	0.4	27,758	67.2	9,416	22.8	2,330	5.7	700	1.7
Caradoc	76,792	75,850	5,656	7.4	1,660	2.3	39,164	51.6	11,392	15.0	3,626	4.8	14,352	18.9
Delaware	30,308	29,944	1,918	6.4	32	0.1	16,246	54.3	2,668	8.9	2,868	9.6	6,212	20.7
East Williams	39,674	39,086	3,332	8.5	1,486	3.8	19,070	48.8	11,798	30.2	2,698	6.9	702	1.8
Ekfrid	54,642	53,842	3,592	6.7	1,948	3.6	33,794	62.8	11,300	21.0	1,760	3.2	1,448	2.7
Lobo	48,194	47,802	3,198	6.7	556	1.2	27,764	58.1	12,484	26.1	2,560	5.3	1,240	2.6
London	108,434	107,160	5,042	4.7	1,274	1.2	63,420	59.2	17,322	16.1	7,162	6.7	12,940	12.1
Metcalfe	36,992	36,362	2,874	7.9	1,734	4.8	21,564	59.3	7,568	20.8	1,896	5.2	726	2.0
Mosa	49,704	48,742	8,848	18.2	2,820	5.8	27,560	56.5	5,718	11.7	2,108	4.3	1,688	3.5
McGillivray	68,660	67,968	5,434	8.0	2,488	3.7	41,156	60.6	14,324	21.1	3,380	5.0	1,186	1.6
North Dorchester	54,204	53,636	4,750	8.9	520	1.0	38,702	72.1	4,518	8.4	3,338	6.2	1,808	3.4
Westminster	66,088	65,190	2,890	4.4	290	0.4	45,652	70.0	4,572	7.0	4,448	6.9	7,338	11.3
West Missouri	51,982	51,488	1,754	3.4	518	1.0	36,326	70.6	7,524	14.6	3,928	7.6	1,438	2.8
West Williams	36,468	35,878	3,892	10.9	1,446	4.0	19,620	54.7	7,814	21.8	2,200	6.1	906	2.5
MIDDLESEX COUNTY	809,548	799,568	56,504	7.1	18,298	2.3	482,104	60.3	141,942	17.7	46,486	5.8	54,234	6.8
Charlotteville	60,936	60,734	17,452	28.7	3,508	5.8	33,454	55.1	2,394	3.9	2,302	3.8	1,624	2.7
Houghton	34,196	33,892	6,246	18.4	756	2.2	22,998	67.9	764	2.3	2,266	6.7	862	2.5
Middleton	46,804	46,368	6,276	13.5	796	1.7	32,440	70.0	1,292	2.8	3,696	8.0	1,868	4.0
North Walsingham	41,078	40,712	6,116	15.0	116	0.3	29,966	73.6	578	1.4	3,156	7.8	780	1.9
South Walsingham	55,420	55,056	9,266	16.8	14,030	25.5	22,038	40.0	2,150	3.9	5,226	9.5	2,346	4.3
Townsend	66,102	65,268	4,558	7.0	898	1.4	51,830	79.4	4,180	6.4	1,596	2.4	2,206	3.4
Windham	68,028	67,592	8,828	13.1	1,960	2.9	49,694	73.5	2,490	3.7	2,458	3.6	2,162	3.2
Woodhouse	36,974	36,654	2,666	7.3	282	0.8	27,228	74.3	2,946	8.0	664	1.8	2,868	7.8
NORFOLK COUNTY	409,538	406,276	61,408	15.1	22,346	5.5	269,648	66.4	16,794	4.1	21,364	5.3	14,716	3.6
Bertie	37,878	37,306	2,982	8.0	338	0.9	21,820	58.4	2,298	6.2	1,188	3.2	8,680	23.3
Crowland	21,326	21,050	2,080	9.9	608	2.9	13,332	63.3	1,082	5.2	386	1.8	3,562	16.9
Humberstone	32,478	31,778	3,134	9.9	1,604	5.0	20,124	63.3	1,696	5.3	1,078	3.4	4,142	13.1
Pelham	30,226	29,852	2,496	8.4	298	1.0	22,496	75.4	1,406	4.7	1,322	4.4	1,834	6.1
Stamford	25,200	24,762	1,370	5.5	428	1.7	10,504	42.5	1,242	5.0	496	2.0	10,722	43.3
Thorold	26,660	25,222	1,896	7.5	364	1.4	15,752	62.5	2,060	8.2	1,044	4.1	4,106	16.3
Wainfleet	52,508	51,782	4,086	7.8	3,302	6.4	38,204	73.8	2,798	5.4	1,324	2.6	2,068	4.0
Willoughby	19,812	19,458	1,882	9.7	304	1.5	15,012	77.2	668	3.4	294	1.5	1,298	6.7
WELLAND COUNTY	246,088	241,210	19,926	8.2	7,246	3.0	157,244	65.2	13,250	5.5	7,132	3.0	36,412	15.1
TOTAL—L. ERIE DISTRICT	4,206,946[2]	4,149,706[2]	321,224	7.7	107,624	2.6	2,904,416	70.0	343,070	8.3	158,806	3.8	314,566[2]	7.6

[1] Other areas include all land administered by the Federal Government, and roads, railways, villages, towns, cities, gravel-pits, etc.

[2] These totals include land areas administered by the Federal Government.

Forest Land Ownership

Land settlement, from the earliest days, has been accompanied by various regulations under which certain tree species, principally oak and pine, were reserved to the Crown. Pine trees were reserved on land located as free grants by The Act of 1868, but they were returned to the grantee with the land when patent was issued. After 1880, however, the usual practice in Ontario was to reserve pine timber to the Crown when the patent was issued.

This condition existed until 1937, except that in 1913 an amendment to The Public Lands Act provided that where land was not in timber licence and the locatee was in residence with improvements, he could request that pine trees be included in the patent, or in the event that patent had previously been issued, he could request a pine patent.

The Public Lands Amendment Act, 1946, granted to the patentee all species of timber on land disposed of for agricultural purposes and patented prior to May 1, 1880. Subsequently, all pine reservations were removed from lands patented for agricultural purposes, regardless of the date of patent (Stat. 1951, chap. 71).

The Forestry Act (Stat. 1952, chap. 32) permits the Minister of Lands and Forests to enter into an agreement with the owners of lands that are suitable for forestry purposes for the reforestation and management of such lands for a stated period of years, which must not be less than 20 years.

Under the terms of The Trees Act (R.S.O. 1950, chap. 399), municipalities may purchase land and either place the responsibility of reforestation and management in the hands of the Province through co-operative agreements, or carry out the planting and management of the forests without an agreement. The agreement provides that the Province will assume the responsibility for re-establishment and care of the forest for a stated period of years, usually fifty in recent agreements. At the end of the agreed period, the municipality may exercise one of three options: first, to renew the agreement; second, to take over the project by paying to the Crown the cost of the development without interest, while revenue received by the Province during the period of the agreement is credited to the project; third, to relinquish title to the land and receive its original purchase price.

The Conservation Authorities Act (R.S.O. 1950, chap. 62) permits the "Authority" to enter into an agreement with the Minister of Lands and Forests for the administration of Authority Forests. These agreements are similar, although not identical, to those entered into by the municipalities and the Crown.

Within the Lake Erie district 4,053,572 acres, or 98 per cent of the area, is classified as patented land. Only 73,202 acres, or 2 per cent of the area, is administered by the Crown. The Crown area is made up of 15,962 acres, or 22 per cent, of land, and 57,240 acres, or 78 per cent, of inland water.

For the purposes of this report, the Crown areas include 380 acres of county forests in Kent and Middlesex Counties and 2,888 acres of authority forests in the Ausable, Upper Thames, Big Creek

TABLE 3. — *Classification of productive forest land into types and age classes.*

Age class and cover type	Crown land	Patented land	Total	
	acres	*acres*	*acres*	*per cent*
Mature forest:				
Coniferous	....	....	....	.....
Hardwood	2,248	60,932	63,180	20
Mixedwoods	....	940	940	*
TOTAL	2,248	61,872	64,120	20
Immature forest:				
Coniferous	38	400	438	*
Hardwood	3,936	119,182	123,118	38
Mixedwoods	74	5,808	5,882	2
TOTAL	4,048	125,390	129,438	40
All-aged forest:				
Hardwood	1,012	69,184	70,196	22
Mixedwoods	80	2,952	3,032	1
TOTAL	1,092	72,136	73,228	23
Young growth:				
Coniferous	....	194	194	*
Hardwood	370	38,500	38,870	12
Mixedwoods	....	1,452	1,452	1
TOTAL	370	40,146	40,516	13
Reproducing forest	2,844	11,078	13,922	4
TOTAL PRODUCTIVE FOREST	10,602	310,622	321,224	100

* Less than one per cent.

and Otter Creek Authorities administered by the Minister of Lands and Forests under the authority of The Forestry Act. Crown lands also include ten Provincial Parks totalling 10,230 acres and the provincial forest tree nursery of 4,200 acres established at St. Williams in 1908.

Age Classes

A forest, to produce sustained timber yields, should be made up of trees of all age classes and stages of development from seedlings to mature timber, in such proportions that when one group of trees is harvested, another is ready to take its place.

The total productive forest area of the Lake Erie district is classed as 20 per cent mature, 40 per cent immature, 23 per cent all-aged, 13 per cent young growth and 4 per cent reproducing forest (table 3, fig. 4).

Patented lands, totalling 310,622 acres, or 97 per cent of the productive forest area, have an identical distribution to that for the total productive forest area.

On Crown lands, which occupy only 3 per cent of the productive forest area, the mature forest covers 21 per cent, the immature 38 per cent, the all-aged 10 per cent, young growth 4 per cent and reproducing forest 27 per cent.

Regional Forest Types

Except for Biddulph Township, the Lake Erie district lies wholly within the Deciduous Forest Region. This region, which occupies the greater part of the eastern United States, makes its only occurrence in Canada in this southwestern region of Ontario.

Here the favourable climatic conditions, with a growing season of over 150 days, coupled with fertile soil, have led to a highly developed agricultural area and the resultant elimination of most of the original forest cover. Forests now occur mainly as woodlots, restricted to poorer and moister sites, or as coniferous plantations of introduced species, on the light, sandy soils.

Separate volume and yield tables are prepared for each region, or section, and they serve as units in the compilation of volume estimates. Two forest sections occur within the Lake Erie district, as follows:

1. The Niagara section, of the Deciduous forest region, occupies 99 per cent of the total area.

2. The Huron section, of the Great Lakes–St. Lawrence forest region, occurs in Biddulph Township, one per cent of the total area.

In the Niagara section, the associations are predominantly composed of deciduous trees. This section contains the main Canadian distribution of sycamore, swamp white oak, black walnut and shagbark hickory. Many broadleaved trees find their northern limit here, including the chestnut, tulip tree, mockernut and pignut hickories, chinquapin, chestnut, scarlet and pin oaks, blue ash,

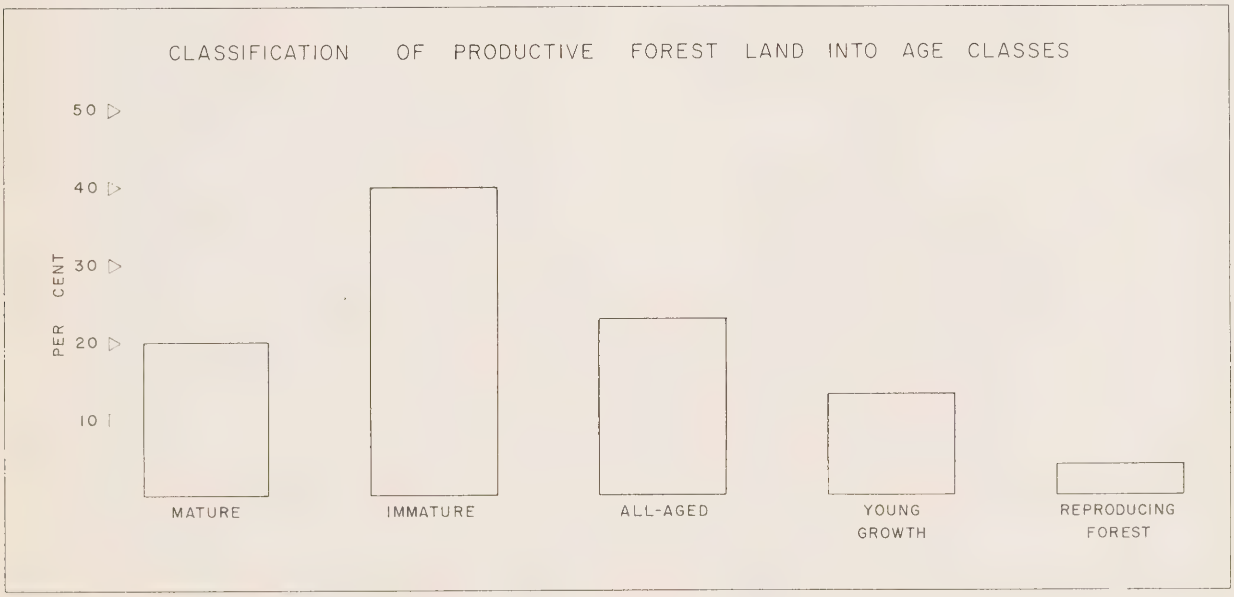


FIGURE 4

black gum, magnolia, papaw, Kentucky coffee tree, redbud, red mulberry and sassafras. Also included are the more widely distributed butternut, bitternut hickory, rock elm, silver maple and blue beech. Except for plantations, conifers are poorly represented.

The Huron section supports a broadleaved forest in which sugar maple and beech are the principal species, while elm and soft maple are common. Many other deciduous trees occur as scattered groups or individuals in the region.

Forest distribution in this district has been greatly influenced by the use of land for agricultural purposes, and by industrial and urban development. Its occurrence has been further influenced by the effect of local land forms, or minor physiographic regions[1] (fig. 5), on land settlement. A general description of these regions is given below:

1. *Huron Fringe.* — A narrow area adjacent to Lake Huron made up of the wave-cut terraces, with their boulders, gravel bars and sand dunes, of glacial lakes.

2. *Huron Slope.* — A clay plain, rising 600 to 900 feet above sea-level, is modified by a narrow strip of sand and the twin beaches of glacial Lake Warren.

3. *Horseshoe Moraines.* — The southern portions of the eastern and western arms of these moraines occur in this district. The western arm consists of knobby clay ridges flanked by a spillway, while the eastern arm is more hilly and stony and contains more sand and gravel.

4. *St. Clair Clay Plains.* — Covering some 2,270 square miles, this is the largest physiographic region in the district. The area is one of little relief, in which minor variations in elevation have had a great effect on the vegetation and soils. Essex County and the adjacent parts of Kent are underlain by limestone, while the remainder is underlain by black shale.

Within this plain, four areas have been described separately.

Essex County and southwestern Kent form a fairly uniform region called the Essex clay plain, which belongs to the northern fringe of the American corn belt. Parts of it are devoted to such early truck crops as tomatoes, strawberries, sweet corn and cucumbers.

[1] L. J. Chapman and D. F. Putnam. The Physiography of Southern Ontario, University of Toronto Press, 1951.

The Lambton clay plain, an area with a shallow layer of clay on the till, occurs in Lambton County. It is an area of faint knoll and sag relief, having somewhat better drainage than the Essex clay plain, and a greater portion of the land is devoted to pasture.

The Chatham flats occupy a 256 square mile area east of Lake St. Clair. This flat area of highly productive, fertile, durable soils remained undeveloped until artificial drainage was established by the municipalities. It is largely devoted to the production of cash crops such as corn, sugar beets, soybeans, tobacco, tomatoes and peas.

The St. Clair delta, at the mouth of the St. Clair River, consists of a series of islands. It is a marshy area, with the outer border formed by a meadow.

5. *Erie Spits.* — Three great sand spits, Long Point, Rondeau and Point Pelee, extend into Lake Erie. Much of their area is at lake level, or lower, and the climate is, next to Pelee Island, the most temperate in Ontario.

6. *Pelee Island.* — Covering 15 square miles, this island, with adjacent islets, is the southernmost land in Canada. The moderately deep clay plain is drained by deep drainage canals and ditches. It has the longest growing season in Canada, and soybeans form the principal crop. During the past few years the island has been noted for its pheasants, and fees for hunting these birds provide a considerable revenue.

7. *Bothwell Sand Plain.* — This plain, the delta of the Thames River in glacial Lake Warren, covers about 700 square miles. A thin layer of sand over clay has produced a high water table. This is an area of low-grade soil, with a high proportion of the wetter parts remaining under forest cover.

8. *Ekfrid Clay Plain.* — An area of stratified clays with occasional knolls or ridges of sand and gravel superimposed on the clay. The soil is good, but agriculture is limited by slow drainage. Over half of this small plain is devoted to pasture.

9. *Caradoc Sand Plain.* — This area of small plains has an overburden of sand or other light-textured, waterlaid deposits.

10. *Stratford Till Plain.* — A broad clay plain, sloping to the southwest, this ground moraine is interrupted by several terminal moraines. A brown

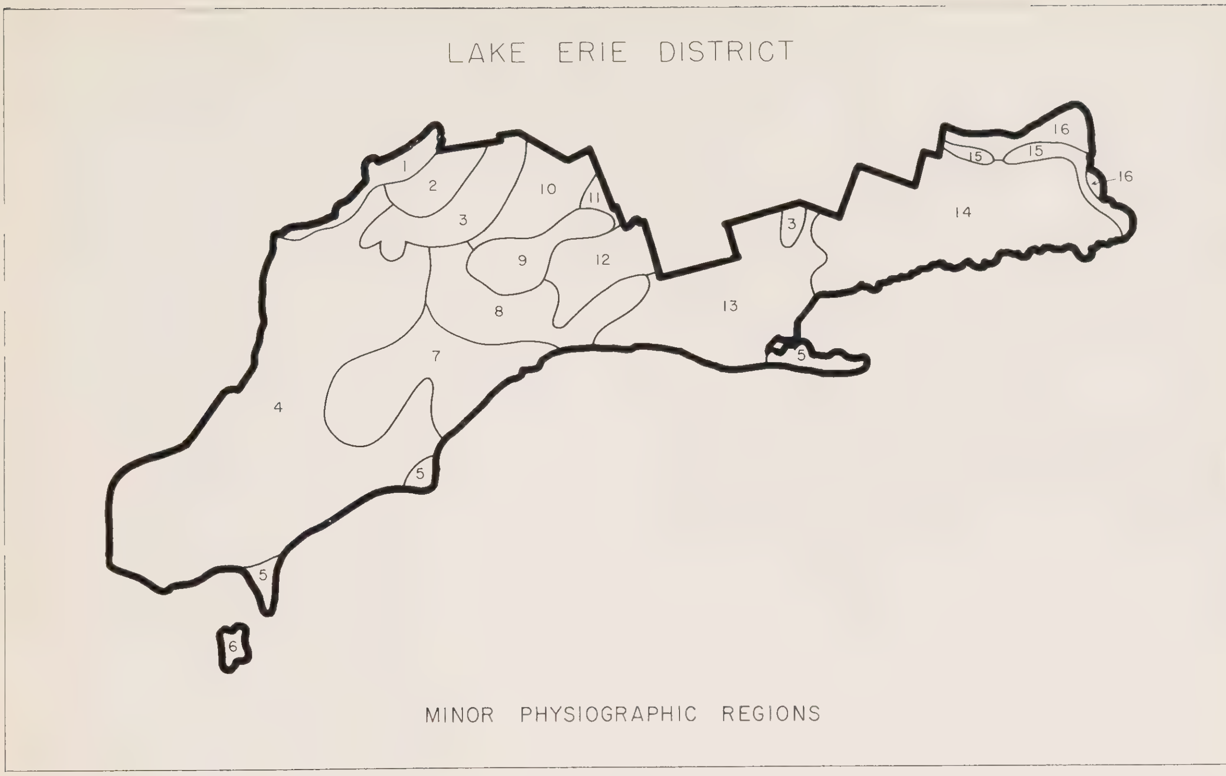


FIGURE 5

calcareous silty clay till is fairly uniform throughout this area.

11. *Oxford Till Plain.* — A good soil, composed of brown calcareous till, characterizes this undulating upland area.

12. *Mount Elgin Ridges.* — Well-drained morainic ridges of pale brown calcareous clay loam lie about 100 feet above poorly drained valleys containing alluvial gravel, sand and silt loam.

13. *Norfolk Sand Plain.* — Including the greater part of Norfolk county and the eastern end of Elgin County, this is an area of silt and clay beds deeply overlain by 30 to 75 feet of sand. Drainage is to Lake Erie by small streams which have cut deep valleys into the sand plain. Abundant well-water is a feature of this area. After original clearing the original humus was rapidly exhausted, productivity declined, wind erosion increased and many farms were abandoned. A forest tree nursery was established at St. Williams to assist a reforestation programme. In recent years the sandy, infertile soils have been utilized extensively for tobacco growing.

14. *Haldimand Clay Plain.* — A confused intermixture of stratified clay and till, it consists of a series of parallel belts commencing at the high ground adjoining the Niagara escarpment. The central portion of the plain is much dissected by tributary drainage. The southeastern part of the peninsula is characterized by levelness and poor drainage. The clay plain is broken by several regions of light-textured soils on which specialized types of agriculture are developing. In general, the plain is devoted to general farming with the emphasis on livestock.

15. *Niagara Escarpment.* — The escarpment forms a simple topographic break, about 300 feet high, between the two levels of the Niagara Peninsula. In some places, there is a broad sloping bench covered by several feet of boulder clay, between the escarpment and the old Iroquois shoreline. There are several breaks in this stretch, some of which provide easy access over the ridge.

16. *Iroquois Plain.* — Within this district, the plain consists of the Niagara fruit belt developed on the sandy soils east of Grimsby. These shallow beds of sand overlying clay present a problem in drainage. West of Grimsby, the red clay soil is heavy in texture and low in permeability, and thus dries out rapidly.

Cover Types

Many of the species occurring within the Lake Erie district have only a scattered representation and do not occur in sufficient volume to be recorded in this report. A large number of the deciduous species characteristic of the Niagara ecological section are in this category, along with some exotic species introduced in the plantations of the district. Volumetric data are shown for 5 coniferous and 16 broadleaved species.

The forests of the district are described under three main cover types: coniferous, hardwood and mixedwoods. The coniferous type is one in which 75 per cent or more of the number of trees are conifer or softwood trees; the hardwood type is composed of 75 per cent or more of hardwood or broadleaved trees. All other combinations are classed as mixedwoods. In addition to the three main cover types, there are small areas of recently established natural reproduction that have not yet attained a sufficiently stable composition to be classified into cover types. The artificially established plantations are areas of reproduction which have been classified according to cover type.

Table 4. — *Classification of productive forest lands into cover types.*

Cover type and age class	Crown land		Patented land		Total	
	acres	*per cent*	*acres*	*per cent*	*acres*	*per cent*
Coniferous type:						
Mature	....	....	....	....	....	....
Immature	38	*	400	*	438	*
Young growth	....	....	194	*	194	*
Plantations	2,844	27	9,712	3	12,556	4
Total	2,882	27	10,306	3	13,188	4
Hardwood type:						
Mature	2,248	21	60,932	20	63,180	20
Immature	3,936	37	119,182	38	123,118	38
All-aged	1,012	10	69,184	22	70,196	22
Young growth	370	3	38,500	13	38,870	12
Plantations	....	....	492	*	492	*
Total	7,566	71	288,290	93	295,856	92
Mixedwoods type:						
Mature	....	....	940	*	940	*
Immature	74	1	5,808	2	5,882	2
All-aged	80	1	2,952	1	3,032	1
Young growth	....	....	1,452	1	1,452	1
Plantations	....	....	....	....	....	....
Total	154	2	11,152	4	11,306	4
Reproducing forest	....	....	874	*	874	*
TOTAL PRODUCTIVE FOREST	10,602	100	310,622	100	321,224	100

* Less than one per cent.

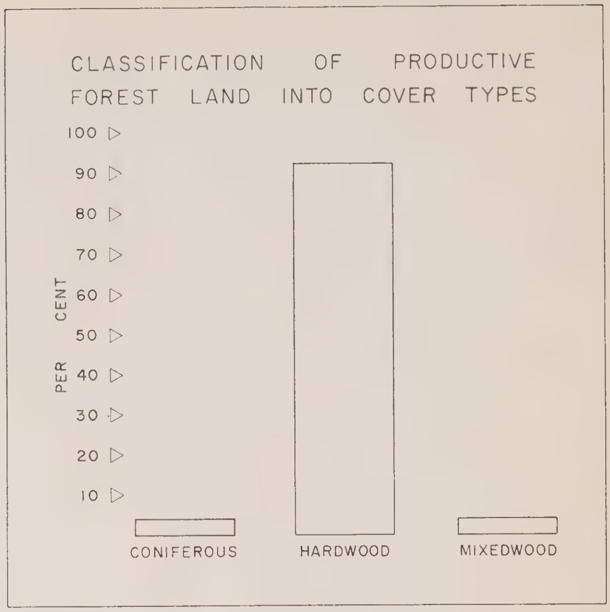


Figure 6

The hardwood type occupies 92 per cent of the productive forest land (table 4); the mixedwoods type and the coniferous type each cover 4 per cent (fig. 6). The distribution on patented land varies only 1 per cent from these figures.

On Crown land, the hardwood type occurs on 71 per cent of the productive forest area, the coniferous type on 27 per cent, and the mixedwoods type on 2 per cent.

There are 874 acres within the district classed as reproducing forest. In addition, there are 12,556 acres of coniferous plantations and 492 acres of hardwood plantations. Thus, the total area classified as reproducing forest amounts to only 13,922 acres.

Volume

The volume of the primary growing stock includes all living trees 3.6 inches d.b.h. outside bark and over which are standing on the productive forest lands of the district; it consists of the wood volume inside bark in cubic feet, including stump and top and cull

or defective portions of living trees, but excludes all limb wood.

The volume of the primary growing stock on productive forest lands in the Lake Erie district is just over 596 million cubic feet (596,520,000 cubic feet). This is an average of 1,857 cubic feet per acre (table 5). The mature age class contains 185.3 million cubic feet (table 6), or 2,890 cubic feet per acre; the immature age class contains 217.9 million cubic feet, or 1,684 cubic feet per acre; and the all-aged stands contain 193.3 million cubic feet, or 2,640 cubic feet per acre.

Crown lands in the Lake Erie district have just under 16 million cubic feet (table 7), or an average of 1,480 cubic feet per acre. The mature age class contains 7.1 million cubic feet or 3,170 cubic feet per acre; the immature 5.7 million cubic feet, or 1,403 cubic feet per acre; and the all-aged stands, 2.9 million cubic feet, or 2,645 cubic feet per acre.

Patented lands within the district have a primary growing stock of almost 581 million cubic feet (table 8), averaging 1,870 cubic feet per acre. The mature age class totals 178.2 million cubic feet, or 2,880 cubic feet per acre; the immature age class contains 212.2 million cubic feet, or 1,692 cubic feet per acre; and all-aged stands contain 190.4 million cubic feet (fig. 7), or 2,640 cubic feet per acre.

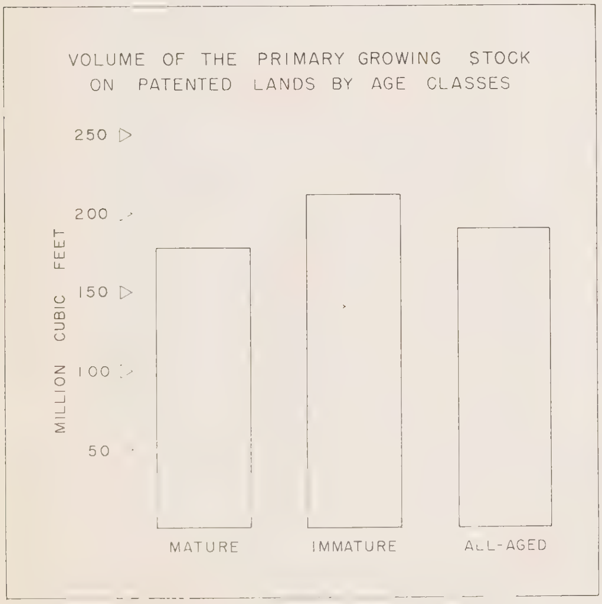


FIGURE 7

TABLE 5. — *Volume per acre of the primary growing stock.*

	Crown land			Patented land			Average Total
	4″–9″ d.b.h.	10″ up d.b.h.	Average total	4″–9″ d.b.h.	10″ up d.b.h.	Average total	
	cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Mature	564	2,606	3,170	514	2,366	2,880	2,890
Immature	776	627	1,403	935	757	1,692	1,684
All-aged	836	1,809	2,645	832	1,808	2,640	2,640
Productive forest	502	978	1,480	673	1,197	1,870	1,857

Larval galleries of the European elm bark beetle on the inner bark surface of elm.

TABLE 6. — *Cubic-foot volumes of primary growing stock on productive forest land (Crown plus patented land) in the Lake Erie district by species group, age class, and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	590	320	....	....	910
Hardwood	32,464	150,111	113,660	92,342	57,980	126,829	573,386
Mixedwoods	575	2,135	6,178	4,828	2,928	5,580	22,224
TOTAL	33,039	152,246	120,428	97,490	60,908	132,409	596,520

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	465	152	....	....	617
Hardwood	2	6	222	837	354	1,037	2,458
Mixedwoods	243	796	2,187	1,136	1,022	2,186	7,570
TOTAL	245	802	2,874	2,125	1,376	3,223	10,645

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total all lands
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	125	168	....	....	293
Hardwood	32,461	150,105	113,438	91,505	57,626	125,791	570,926
Mixedwoods	333	1,339	3,991	3,692	1,906	3,395	14,656
TOTAL	32,794	151,444	117,554	95,365	59,532	129,186	585,875

TABLE 7. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Erie district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	54	29	....	....	83
Hardwood	1,267	5,859	3,006	2,445	836	1,829	15,242
Mixedwoods	....	....	80	63	77	147	367
TOTAL	1,267	5,859	3,140	2,537	913	1,976	15,692

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	43	14	....	....	57
Hardwood	....	....	5	22	5	15	47
Mixedwoods	....	....	28	15	27	58	128
TOTAL	....	....	76	51	32	73	232

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total Crown land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	11	15	....	....	26
Hardwood	1,267	5,859	3,001	2,423	831	1,813	15,194
Mixedwoods	....	....	52	48	50	90	240
TOTAL	1,267	5,859	3,064	2,486	881	1,903	15,460

Table 8. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Erie district by species group, age class and cover type in two size classes.*

ALL SPECIES

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	537	291	....	....	828
Hardwood	31,196	144,252	110,653	89,897	57,144	125,000	558,142
Mixedwoods	576	2,135	6,098	4,765	2,851	5,433	21,858
Total	31,772	146,387	117,288	94,953	59,995	130,433	580,828

ALL CONIFERS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu.ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	422	138	....	....	560
Hardwood	2	6	217	815	350	1,022	2,412
Mixedwoods	243	796	2,159	1,121	994	2,128	7,441
Total	245	802	2,798	2,074	1,344	3,150	10,413

ALL HARDWOODS

Cover type	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
Coniferous	....	....	114	153	....	....	267
Hardwood	31,194	144,246	110,437	89,082	56,795	123,978	555,732
Mixedwoods	333	1,339	3,939	3,644	1,856	3,305	14,416
Total	31,527	145,585	114,490	92,879	58,651	127,283	570,415

White elm tree with advanced stage of the Dutch Elm disease.

Species

Hardwood species, totalling almost 586 million cubic feet (table 9), comprise 98 per cent of the volume in the Lake Erie district. Conifers, which comprise the remaining 2 per cent, have a volume of 10.6 million cubic feet.

Nine species comprise 89 per cent of the volume on productive forest land (fig. 8). Elm is the principal species within the district, comprising 29 per cent of the total growing stock. It is followed by soft maple and sugar maple, which form 17 and 10 per cent, respectively, of the total growing stock. White ash comprises 8 per cent, beech 7 per cent, red and white oak 5 per cent each, and basswood and poplar 4 per cent each. White pine is the principal conifer, with 49 per cent of the coniferous volume, which represents just under one per cent of the total growing stock.

In the mature age class five species make up 79 per cent of the volume; elm 31 per cent, soft maple 21 per cent, sugar maple 12 per cent, beech 8 per cent and white ash 7 per cent. Sixty-two per cent of the immature volume is contained in five species: elm 27 per cent, soft maple 13 per cent, white ash

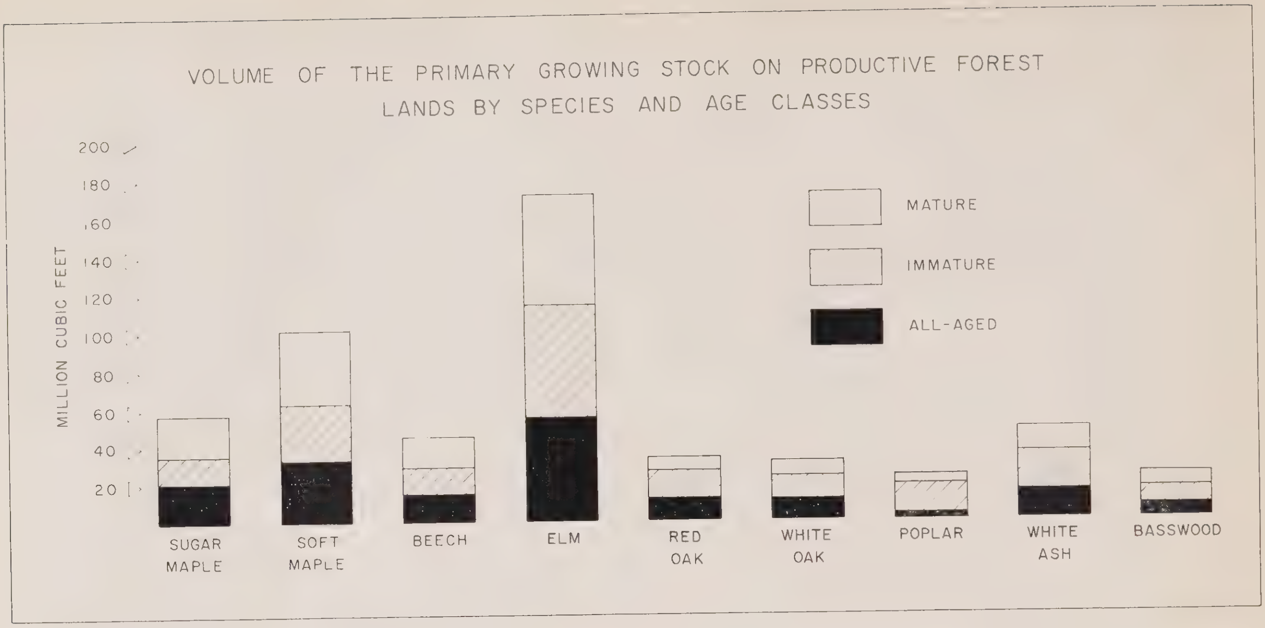


FIGURE 8

9 per cent, beech 7 per cent and sugar maple 6 per cent. In the all-aged stands elm forms 28 per cent, soft maple 17 per cent and sugar maple 11 per cent.

Crown lands have nearly 16 million cubic feet (table 10), of which 99 per cent is hardwoods. The principal species are elm, soft maple, sugar maple, white ash and beech. In the immature age class poplar replaces beech as the fifth species, and in the all-aged stands beech has a slightly higher volume than white ash.

Patented lands have 10 million cubic feet of coniferous volume and 570 million cubic feet of hardwood volume (table 11). The principal species are elm, soft maple and sugar maple. Elm comprises 31 per cent of the mature, 27 per cent of the immature, and 28 per cent of the volume in the all-aged stands. Soft maple forms 21 per cent of the mature, 13 per cent of the immature and 17 per cent of the all-aged volume, while for hard maple these percentages become 12, 6 and 11, respectively.

Size Class Relationship

In compiling the inventory, volumes of the primary growing stock are shown for two size classes, the smaller material from 4–9 inches d.b.h. and the larger trees 10 inches d.b.h. and over. Volumes in trees 4 to 9 inches d.b.h. are considered as pulpwood and cordwood material, depending on species, although products such as posts, poles and railway ties may be obtained from this size class. Volumes in the 10-inch and over size class have values for sawlogs and other uses where large timber is required. A tree 10 inches d.b.h. outside bark will, on the average, produce one log sixteen feet long, 8 inches in diameter inside bark at the small end. In addition, there is residual smaller-size material in the top which may be used as pulpwood or for

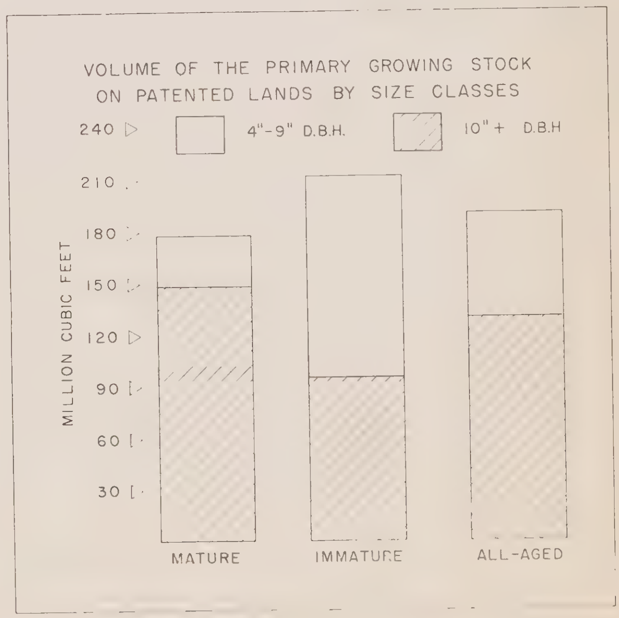


FIGURE 9

Table 9. — *Cubic-foot volumes of primary growing stock on productive forest land in the Lake Erie district by species and age class in two size classes.*

Species	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″–9″ d.b.h.	All-aged 10″ up d.b.h.	Total all lands
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	45	497	526	1,246	663	2,189	5,166
Red pine	...	...	...	...	234	407	641
White spruce	...	...	22	11	...	...	33
Black spruce	...	...	5	...	...	...	5
Balsam fir	...	...	80	8	...	...	88
Hemlock	112	197	188	356	190	498	1,541
White cedar	85	106	1,794	402	289	129	2,805
Larch	3	2	259	102	...	...	366
Total Conifers	245	802	2,874	2,125	1,376	3,223	10,645
Sugar maple	3,965	18,182	8,632	5,365	7,583	13,176	56,903
Soft maple	4,638	33,846	15,519	13,817	10,006	23,314	101,140
White birch	7	13	1,405	226	108	55	1,814
Yellow birch	495	750	2,164	856	1,118	1,073	6,456
Beech	2,426	13,223	6,632	7,628	4,226	10,523	44,658
Elm	8,832	49,020	28,130	30,527	14,743	40,316	171,568
Ironwood	947	153	2,553	119	1,633	260	5,665
Red oak	779	6,294	6,632	6,780	2,903	9,122	32,510
White oak	1,613	6,442	5,764	6,037	3,620	7,375	30,851
Poplar	1,219	3,191	9,988	4,979	1,329	1,904	22,610
Black ash	590	349	2,714	504	1,041	663	5,861
White ash	3,355	9,605	11,782	7,978	4,874	9,942	47,536
Basswood	1,252	6,443	4,037	4,946	1,487	5,570	23,735
Black cherry	567	1,486	2,938	2,136	1,215	2,032	10,374
Butternut	...	1	...	...	226	615	842
Hickory	2,109	2,446	8,664	3,467	3,420	3,246	23,352
Total Hardwoods	32,794	151,444	117,554	95,365	59,532	129,186	585,875
TOTAL ALL SPECIES	33,039	152,246	120,428	97,490	60,908	132,409	596,520

Table 10. — *Cubic-foot volumes of primary growing stock on Crown land in the Lake Erie district by species and age class in two size classes.*

Species	Mature 4″–9″ d.b.h.	Mature 10″ up d.b.h.	Immature 4″–9″ d.b.h.	Immature 10″ up d.b.h.	All-aged 4″–9″ d.b.h.	All-aged 10″ up d.b.h.	Total Crown land
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	...	...	10	32	13	46	101
Red pine	...	...	...	...	6	11	17
White spruce	...	...	2	1	...	...	3
Black spruce	...	...	...	...	...	...	
Balsam fir	...	...	6	1	...	...	7
Hemlock	...	...	3	5	5	13	26
White cedar	...	...	50	11	8	3	72
Larch	...	...	5	1	...	...	6
Total Conifers	...	...	76	51	32	73	232
Sugar maple	153	702	225	141	111	192	1,524
Soft maple	178	1,318	402	354	148	342	2,742
White birch	...	...	33	6	3	1	43
Yellow birch	17	26	51	21	18	16	149
Beech	93	505	176	202	62	158	1,196
Elm	343	1,901	735	787	216	594	4,576
Ironwood	37	6	68	3	24	4	142
Red oak	30	241	175	180	44	138	808
White oak	62	245	152	160	55	108	782
Poplar	47	124	255	128	20	28	602
Black ash	22	13	68	13	16	10	142
White ash	131	375	312	212	71	144	1,245
Basswood	49	251	106	130	22	82	640
Black cherry	22	56	76	57	18	30	259
Butternut	...	...	...	...	3	9	12
Hickory	83	96	230	92	50	47	598
Total Hardwoods	1,267	5,859	3,064	2,486	881	1,903	15,460
TOTAL ALL SPECIES	1,267	5,859	3,140	2,537	913	1,976	15,692

purposes other than saw timber. The total quantity of wood in this residual top is relatively small, and is included in the 10 inches and over material in all inventory estimates.

Patented lands contain 97 per cent of the total wood volume in the Lake Erie district. Considering all age classes on patented land, the 4 to 9-inch class contains 209.1 million cubic feet, or 36 per cent of the volume; and the 10-inch and over d.b.h. class contains 371.8 million cubic feet, or 64 per cent of the total volume (table 11). The 10-inch and over class contains 82 per cent of the mature volume, 45 per cent of the immature volume and 68 per cent of the all-aged volume (fig. 9). When the species groups are considered separately, 58 per cent of the coniferous volume and 64 per cent of the hardwood volume occur in the larger size class.

Coniferous species have 77 per cent of their mature volume and 70 per cent of the all-aged volume in the sawlog size class, while the immature age class produces 57 per cent cordwood material and 43 per cent sawlog material. The principal coniferous species, white pine, has the volume primarily in the 10-inch and up d.b.h. class in all age classes.

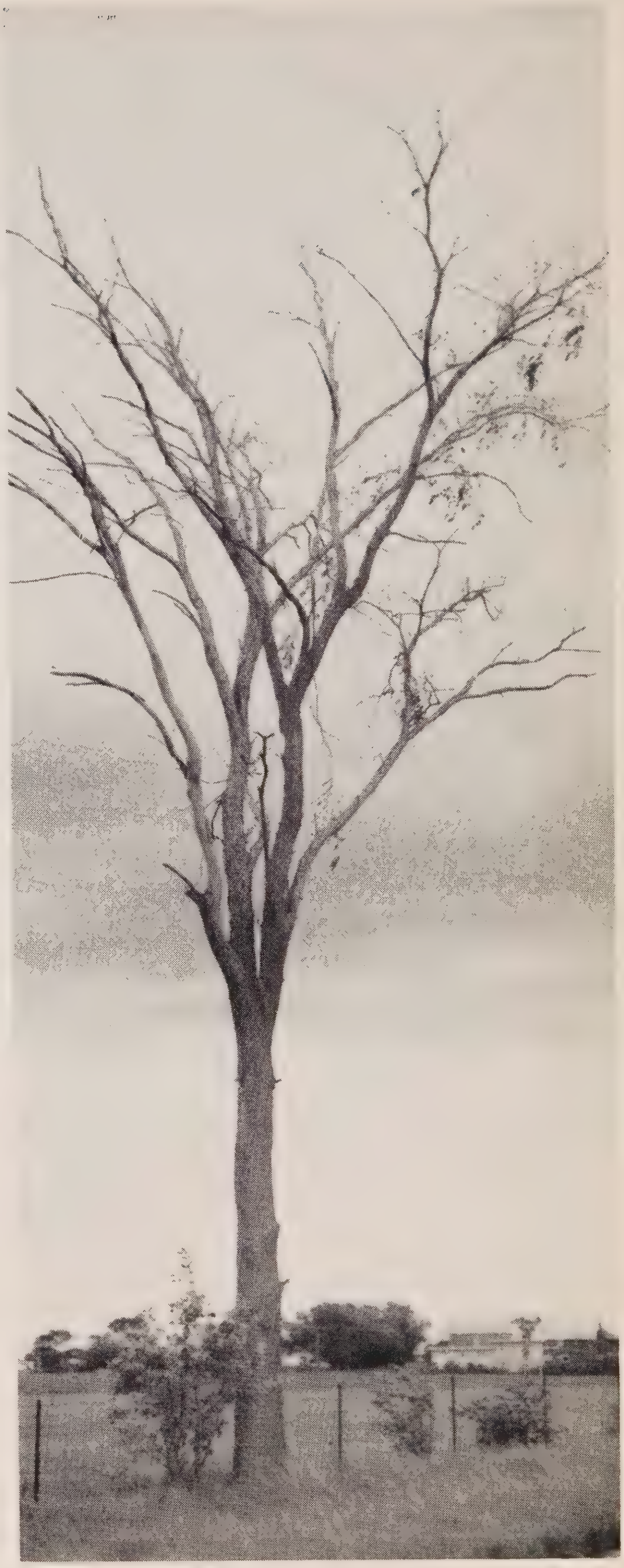
The principal hardwood species in the mature age class produce predominantly sawlog size material

TABLE 11. — *Cubic-foot volumes of primary growing stock on patented land in the Lake Erie district by species and age class in two size classes.*

Species	Mature		Immature		All-aged		Total patented land
	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	4″–9″ d.b.h.	10″ up d.b.h.	
	Thousand cu. ft.	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*	*Thousand cu. ft.*
White pine	45	497	516	1,214	650	2,143	5,065
Red pine	....	....	....	....	228	396	624
White spruce	....	....	20	10	....	....	30
Black spruce	....	....	5	....	....	....	5
Balsam fir	....	....	74	7	....	....	81
Hemlock	112	197	185	351	185	485	1,515
White cedar	85	106	1,744	391	281	126	2,733
Larch	3	2	254	101	....	....	360
TOTAL CONIFERS	245	802	2,798	2,074	1,344	3,150	10,413
Sugar maple	3,812	17,480	8,407	5,224	7,472	12,984	55,379
Soft maple	4,460	32,528	15,117	13,463	9,858	22,972	98,398
White birch	7	13	1,372	220	105	54	1,771
Yellow birch	478	724	2,113	834	1,100	1,057	6,306
Beech	2,333	12,718	6,456	7,426	4,164	10,365	43,462
Elm	8,488	47,119	27,395	29,740	14,527	39,722	166,991
Ironwood	910	147	2,485	116	1,609	256	5,523
Red oak	749	6,053	6,457	6,600	2,859	8,984	31,702
White oak	1,552	6,197	5,612	5,877	3,565	7,267	30,070
Poplar	1,172	3,067	9,733	4,851	1,309	1,876	22,008
Black ash	568	336	2,646	491	1,025	653	5,719
White ash	3,224	9,230	11,470	7,766	4,803	9,798	46,291
Basswood	1,203	6,192	3,931	4,816	1,465	5,488	23,095
Black cherry	545	1,430	2,862	2,080	1,197	2,002	10,116
Butternut	....	1	....	....	223	606	830
Hickory	2,026	2,350	8,434	3,375	3,370	3,199	22,754
TOTAL HARDWOODS	31,527	145,585	114,490	92,879	58,651	127,283	570,415
TOTAL ALL SPECIES	31,772	146,387	117,288	94,953	59,995	130,433	580,828

(fig. 10). This size class contains 82 per cent of the sugar maple volume, 88 per cent of the soft maple, 84 per cent of the beech, 85 per cent of the elm, 89 per cent of the red oak, 80 per cent of the white oak, 72 per cent of the poplar, 74 per cent of the white ash and 84 per cent of the basswood.

In the immature age class, this volume is more evenly divided between the two size classes. Sugar maple, soft maple, poplar and white ash have the greater percentage of their volume in the smaller size class, while beech, elm, red and white oak and basswood have most of their volume in the larger size class (fig. 11).



White elm tree killed by the Dutch Elm disease.

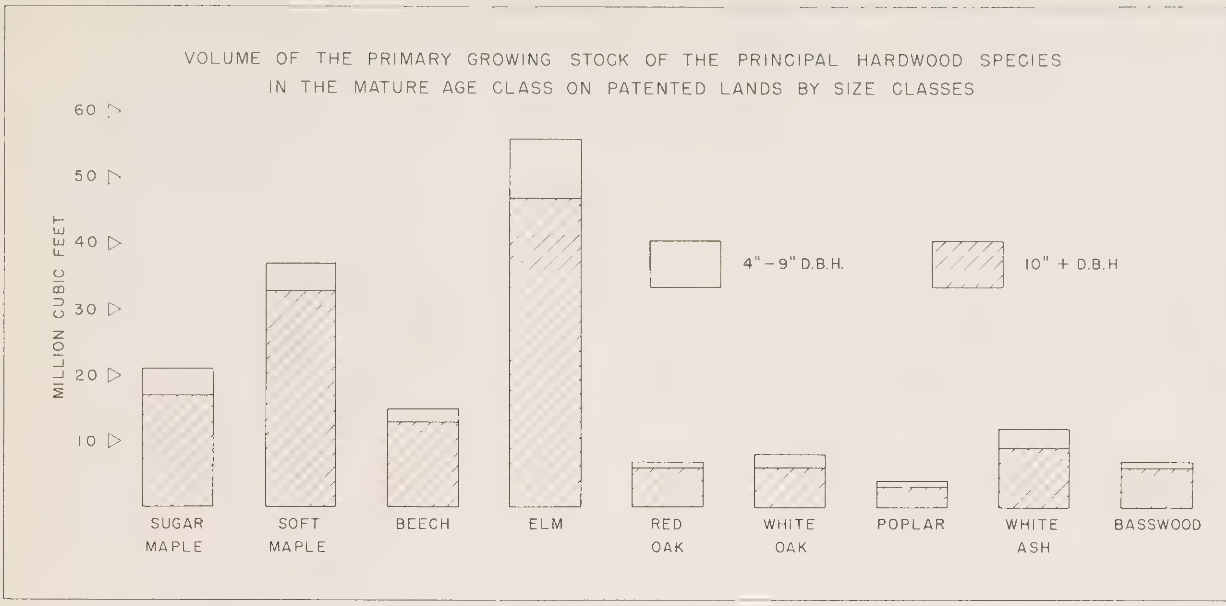


FIGURE 10

The all-aged stands have most of the hardwood volume in the 10-inch and over size class (fig. 12). Sugar maple has 63 per cent of its volume in this class, soft maple 70 per cent, beech 71 per cent, elm 73 per cent, red oak 76 per cent, white oak 67 per cent, white ash 67 per cent and basswood 79 per cent.

Crown lands, with a total volume just under 16 million cubic feet, have 82 per cent of the mature and 68 per cent of the all-aged volume in the larger size class and 55 per cent of the immature volume in the smaller size class.

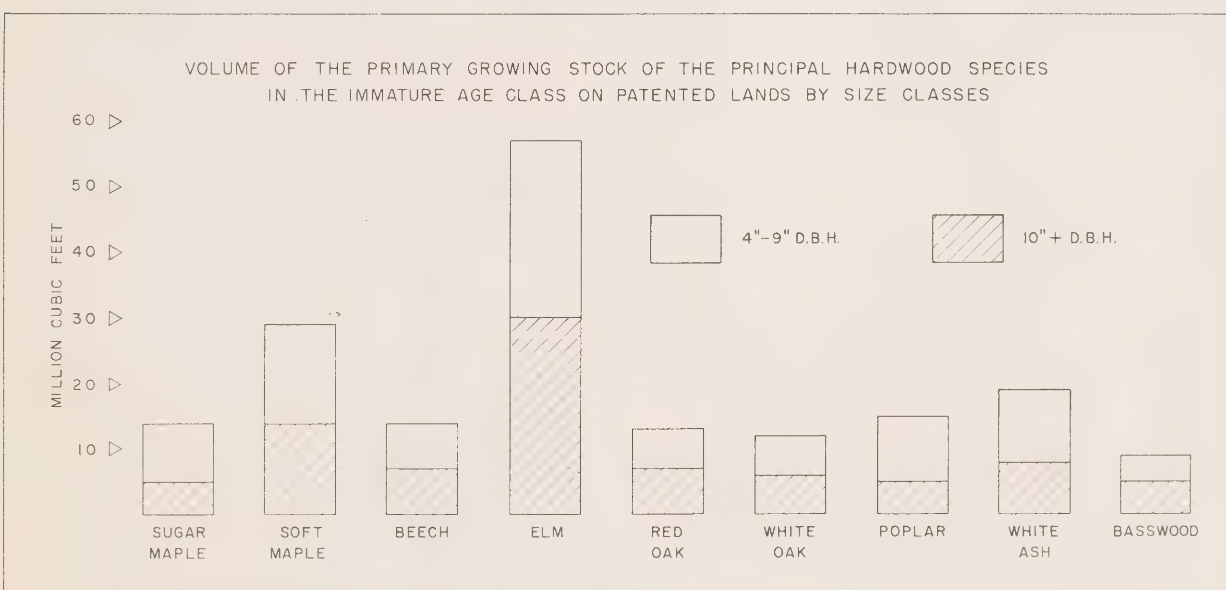


FIGURE 11

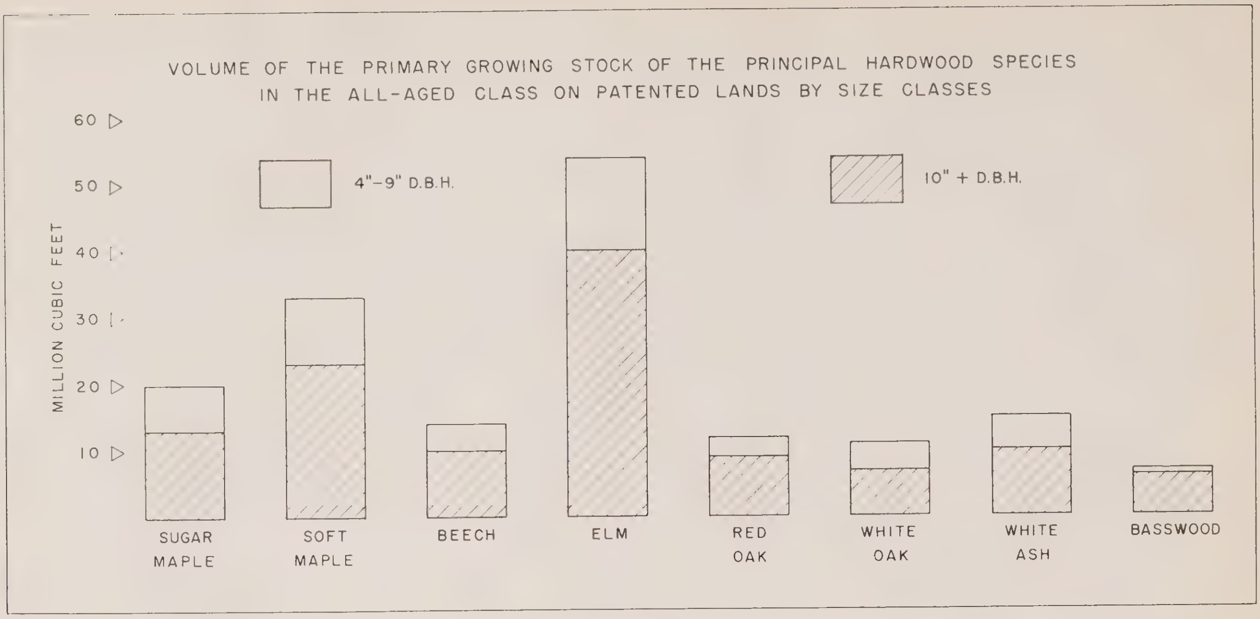


FIGURE 12

Allowable Cut

The allowable cut has been computed for each species with the aid of a volumetric formula[1] and appropriate rotation[2] for the species. Thus the amount of the allowable cut results from the volume of the primary growing stock and the rotation age adopted for each species encountered in the district.

The calculation of allowable cut, based on the present volume of the primary growing stock, is of value for a period of about ten years. The size and structure of the primary growing stock, upon which the allowable cut calculations are based, changes from year to year, owing to woods operations and growth of the stands. Because of this, the allowable cut should be recalculated on expiration of the initial ten-year period. With effective forestry practices, allowable cuts for the valuable species will increase; without them the proportion of less desirable species in the stands will grow greater.

The annual allowable cut, or net depletion, permissible under management in the Lake Erie district is 14,649,165 cubic feet: 184,275 cubic feet from Crown lands and 14,464,890 cubic feet from patented lands. Of the total allowable cut, 99 per cent is on patented lands.

[1] Method of calculation of allowable cut is given in Appendix, methods, allowable cut, page 30.

[2] Rotation, by species, table 15, page 30.

CROWN LAND

The annual allowable cut for Crown land represents only 1.2 per cent of the primary growing stock, or 17.4 cubic feet per acre for the productive forest area. The permissible cut of 184,275 cubic feet (table 12) is composed entirely of deciduous species. Two species comprise 59 per cent of the present allowable cut: soft maple 35 per cent and elm 24 per cent.

TABLE 12. — *Annual allowable cut for all species on Crown lands in the Lake Erie district.*

Species	Annual allowable cut *cu. ft.*
Sugar maple	12,825
Soft maple	64,115
Yellow birch	860
Beech	8,970
Elm	44,880
Ironwood	1,290
Red oak	4,065
White oak	3,070
Poplar	10,260
Black ash	1,050
White ash	15,180
Basswood	10,000
Black cherry	2,340
Hickory	5,370
TOTAL HARDWOODS	184,275
TOTAL ALL SPECIES	184,275

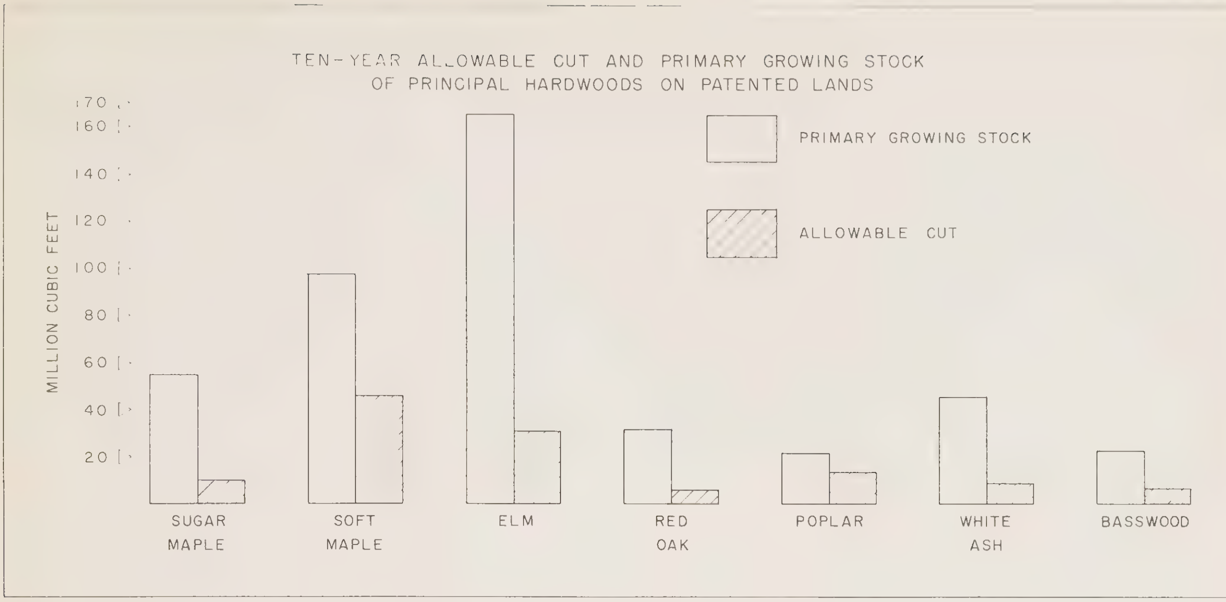


FIGURE 13

PATENTED LAND

The annual allowable cut for patented lands is 14,464,890 cubic feet (table 13). This represents 2.5 per cent of the primary growing stock, or 46.6 cubic feet per acre for the productive forest land.

TABLE 13.--*Annual allowable cut for all species on patented lands in the Lake Erie district.*

Species	Annual allowable cut *cu. ft.*
White pine	105,520
Red pine	19,500
White spruce	935
Black spruce	105
Balsam fir	2,530
Hemlock	18,940
White cedar	51,245
Larch	9,000
TOTAL CONIFERS	207,775
Sugar maple	1,038,360
Soft maple	4,612,405
White birch	55,345
Yellow birch	98,530
Beech	543,275
Elm	3,131,080
Ironwood	103,555
Red oak	594,410
White oak	375,875
Poplar	1,375,500
Black ash	107,230
White ash	867,955
Basswood	721,720
Black cherry	189,675
Butternut	15,560
Hickory	426,640
TOTAL HARDWOODS	14,257,115
TOTAL ALL SPECIES	14,464,890

The annual allowable cut is 2.0 per cent of the primary growing stock for conifers and 2.5 per cent for hardwoods.

Coniferous species comprise only 1.4 per cent of the allowable cut. White pine forms 51 per cent of the coniferous allowable cut, but this represents only 0.7 per cent of the allowable cut for patented lands.

Seventy-one per cent of the hardwood allowable cut is obtained from four of the sixteen hardwood species. Soft maple forms 32 per cent of the allowable cut, elm 22 per cent, poplar 10 per cent, and sugar maple 7 per cent. Figure 13 graphically illustrates the relationship of the allowable cut for a ten-year period to the volume of the primary growing stock for hardwoods.

The smaller European elm bark beetle, Scolytus multistriatus (Marsh.), which is the principal carrier of the Dutch Elm disease. Life size of beetle is about 1/8 inch long.

Forests within the district are generally restricted to the poorer and moister sites.

Utilization vs. Allowable Cut

No statistics relating to the annual cut of timber on Crown lands in the Lake Erie district are collected by the Department of Lands and Forests. This district is essentially an area of privately owned land for which data pertaining to timber production are not readily available. The volume and value of products produced from farm woodlots in 1950[1] is as follows:

Fuelwood	94,848 cords
Posts	14,304 pieces
Logs	3,461,029 board feet
Poles	721 pieces

The above products were estimated[1] to have a value of $778,003. Most of these were utilized directly on the farm, but the remainder produced a cash value of $267,073. In addition, maple syrup and maple sugar produced within the district were valued[1] at $86,393.

[1] Census of Canada, 1951, Volume VI, Table 27.

By the use of appropriate converting factors, the wood volumes are expressed in gross total cubic feet (table 14). Because of the lack of adequate data, no comparison by species is possible. A comparison of the total actual cut derived in this manner with the total allowable cut indicates that patented lands are being overcut annually by 5,201,535 cubic feet. This represents an annual overcut of some 36 per cent, and when coupled with the losses of elm, that appear inevitable due to the Dutch Elm disease, indicates a marked reduction in timber volume within this district during the next decade.

TABLE 14. — *Gross total cubic-foot volume of wood produced from patented land in one year in the Lake Erie district.*

Fuelwood	17,153,360
Posts	40,485
Logs	2,452,175
Poles	20,405
TOTAL	19,666,425

APPENDIX

Survey Methods

• The forest resources inventory for the Province of Ontario was carried out by the Aerial Photographic Method. Photographs were taken from a height of 7,920 feet above mean ground level with a six-inch focal length camera to produce photographs at a scale of four inches to the mile (1/15,840). Following the photography, semi-controlled photo maps were prepared.

A photo map, or aerial mosaic, is an assembly of individual aerial photographs fitted together systematically to form a composite view of the entire area covered by the photographs. In Southern Ontario, a photo map covers 7′30″ of latitude and 15′ of longitude — approximately one hundred square miles. A six-digit index related to latitude and longitude permits the ready location of any photo map.

In constructing a photo map, the prints are mounted on a hard-surface, non-porous board, such as masonite, upon which control points have been plotted. The road network of Southern Ontario has been used to control the scale of the photo maps. To prepare a print for mounting, the central portion is cut out in an irregular shape and the edges are feathered to produce a margin thinner than the remainder of the print. The technique of feathering the edges ensures smoothness as layers of prints are mounted, and makes the edges of the prints less perceptible to the eye and to the camera. After a liberal application of adhesive, the print is oriented on to the control and adjusted to coincide with the detail on adjacent photographs. Upon completion of the mosaic, necessary data are printed on the mosaic in white ink. In order to reduce the inherent instability of the photo map to a minimum, and to avoid checks and other disfigurations, it is photographed as soon as possible after completion. Because of the size of the mosaic it is photographed in two sections, producing an east and a west half for each sheet. Upon production of the negative, prints are readily available.

Interpretation of forest types was carried out on stereoscopic pairs of photographs, and the data were then transferred to the mosaic. Forest data were drafted on a linen overlay, and the ozalid prints of this comprise the forest type maps of this area.

Systematic sampling was carried out by the field crews who collected all the data necessary for making volume estimates. Photographs were taken during the summers of 1954, 1955 and 1956, and field sampling was carried out in the summer of 1957. On the completion of the field work, finished forest type maps were prepared and areas determined by the usual methods[1].

Volume estimates were prepared for type aggregates. For this purpose, types were classified into three cover types: coniferous, hardwood and mixedwoods. These were separated into three age classes: mature, immature and all-aged. The volume per acre for each cover type for the mature and immature age classes was then summarized from the field tallies into three density classes. The all-aged stands were not segregated into density classes. Summaries were made separately for the two ecological sections in the Lake Erie district. The per acre volumes in cubic feet, made up in this manner, are shown in tables 16 and 17.

Mean Annual Increment

The mean annual increment to the rotation age was calculated by dividing the total mature volume for each species by the respective rotation age. The results were totalled and the sum divided by the area of the mature age class.

The mean annual increment to the rotation age for Crown lands amounts to 27 cubic feet per acre, and for patented lands to 39 cubic feet per acre. These figures should be regarded as approximate, since no age class other than the mature was considered in the calculations.

Age Classes

The age classes in their present form do not permit of the usual method of arriving at sustained yield, because there are no figures for areas by species. The immature age class may have an age range from 10 to 120 years and the mature age class from 30 to 300 years, depending on the species. Stands classed as all-aged contain trees that range in age through all the age classes recognized in this report. Therefore, the normal area for each age class cannot be obtained.

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[1] A complete statement of the methods used in the forest resources inventory is contained in the Manual of Timber Management, Department of Lands and Forests, Ontario, Parts II and III.

Rotation

In view of the absence of local studies on maturity of stands, the mature age figures shown in Class Ib[1] were used as rotation ages for each species encountered. In addition, the rotation age of one hundred years has been adopted arbitrarily for the miscellaneous hardwood species (table 15).

TABLE 15. — *Rotation by species.*

Species	Crown land	Patented land
	years	*years*
White pine	120	90
Red pine	100	60
White spruce	100	60
Black spruce	120	90
Balsam fir	90	60
Hemlock	300	150
White cedar	200	100
Larch	100	75
Sugar maple	200	100
Soft maple	70	40
White birch	80	60
Yellow birch	150	120
Beech	200	150
Elm	150	100
Ironwood	100	100
Red oak	200	100
White oak	300	150
Poplar	50	30
Black ash	100	100
White ash	100	100
Basswood	90	60
Black cherry	100	100
Butternut	100	100
Hickory	100	100

Allowable Cut

(a) METHOD

The following two bases were available for calculation of the allowable cut: (1) the volumes of the mature, immature and all-aged stands for each species, and (2) the adopted rotations.

The compilation was carried out in such a way that volumes were shown by species. This suggests the calculation of allowable cut by individual species, separately, rather than for the total primary growing stock in the district, and the method of calculation most suitable to the available data is a volumetric formula.

In view of this, the "French Method of 1883"[2] was considered and found to be satisfactory for the following reasons: 1. The ratio of the volume per acre of mature to immature age class was found to be approximately 5/3 as required by the French method. 2. The French method is recognized as sound enough, though not entirely free from those disadvantages normally connected with the volumetric methods of regulating yield. The method tends to build up a normal growing stock, and the results of the calculations may be considered rather conservative.

(b) FORMULA

In the present calculations, the following formulae were used:

$$\text{(1) Crown land: } P = \frac{V.1.}{n/3}$$

$$\text{(2) Patented land: } P = \frac{\tfrac{5}{8}\,(V.1. + V.2. + V.3.)}{n/3}$$

where:

V.1. — denotes volume of mature timber (Age Class I).

V.2. — denotes volume of immature timber (Age Class II).

V.3. — denotes volume of mature and immature timber in all-aged stands.

n — denotes rotation.

p — denotes allowable cut.

Formula (1) was used for Crown lands, since it is the practice in Ontario to limit utilization on these areas to mature timber. In addition, much of the Crown forest within the district occurs on county and authority forests where it is the present aim to build up the growing stock, rather than to deplete it through operations in immature timber. A considerable proportion also occurs in Provincial Parks, where aesthetic values are likely to be given preference over straight timber values. In view of these considerations, it is felt that during the present rotation, only a limited amount of timber will be extracted from Crown lands.

On patented lands, formula (2) was used since it is reasonable to assume that with a high population and a heavy demand for wood, the owners of these lands will be willing to utilize a portion of their immature stands to satisfy this demand.

With the aid of the above formulae, the allowable cut has been calculated for each species, separately, with full consideration of the actual growing stock of each species and the appropriate rotation. The results of individual calculations for each species have been totalled and shown as allowable cut for Crown lands and for patented lands, respectively.

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[1] Manual of Timber Management, Department of Lands and Forests, Ontario, Part II, page 50.

[2] L. Pardé Traité pratique d'aménagement des forêts, Paris, 1930.

Dutch Elm Disease

The Dutch Elm disease, or Graphium wilt of elm, is well-distributed throughout all the counties of the Lake Erie district. This disease, which attacks all species of American and European elms, is caused by the fungus *Ceratocystis ulmi* (Buism.) C. Moreau. The causal fungus is transmitted from diseased to healthy trees by the native elm bark beetle, *Hylurgopinus rufipes* (Eichh.) and the smaller European elm bark beetle, *Scolytus multistriatus* (Marsh.).

The forested areas of the Lake Erie district contain 172 million cubic feet of elm, which comprises 29 per cent of the total wood volume in the district. Since it will not be economically possible to control the Dutch Elm disease in these areas by chemical treatment, a considerable loss of elm and a consequent reduction of the growing stock in the district appears inevitable.

The calculated allowable cut for elm shown in the report is based on a healthy forest condition. In view of the losses that may be expected from the Dutch Elm disease the allowable cut should be modified, and every effort should be made to increase the utilization of elm to a maximum. In addition, sanitation cuts should be made, where possible, to remove diseased trees and stands, and thus reduce the rate of spread of the disease.

Photographs of the elm trees and bark beetle are the work of Miss J. F. Robinson, and were kindly supplied by the Forest Biology Laboratory, Canada Department of Agriculture, Maple, Ontario.

Common and Botanical Names of Tree Species Included in Timber Estimates

CONIFERS

Common name	Botanical name
White pine	*Pinus Strobus L.*
Red pine	*Pinus resinosa Ait.*
Jack pine	*Pinus Banksiana Lamb.*
Scots pine	*Pinus sylvestris L.*
White spruce	*Picea glauca (Moench) Voss*
Black spruce	*Picea mariana (Mill.) BSP.*
Norway spruce	*Picea abies (L.) Karst.*
Balsam fir	*Abies balsamea (L.) Mill.*
Hemlock	*Tsuga canadensis (L.) Carr.*
White cedar	*Thuja occidentalis L.*
Eastern larch	*Larix laricina (Du Roi) K. Koch*
European larch	*Larix decidua Mill.*

HARDWOODS

Common name	Botanical name
Sugar maple	*Acer saccharum Marsh.*
Soft maple	*Acer rubrum L.* *Acer saccharinum L.*
White birch	*Betula papyrifera Marsh.*
Yellow birch	*Betula lutea Michx. f.*
Beech	*Fagus grandifolia Ehrh.*
Elm	*Ulmus americana L.* *Ulmus rubra Muhl.* *Ulmus Thomasi Sarg.*
Ironwood	*Ostrya virginiana (Mill.) K. Koch*
Red oak	*Quercus rubra L.* *Quercus palustris Muenchh.* *Quercus velutina Lam.*
White oak	*Quercus alba L.* *Quercus macrocarpa Michx.* *Quercus bicolor Willd.* *Quercus Muehlenbergii Engelm.* *Quercus prinoides Willd.*
Poplar	*Populus tremuloides Michx.* *Populus balsamifera L.* *Populus grandidentata Michx.* *Populus deltoides Marsh.*
Black ash	*Fraxinus nigra Marsh.*
White ash	*Fraxinus americana L.* *Fraxinus pennsylvanica Marsh.* *Var. subintegerrima (Vahl) Fern.*
Basswood	*Tilia americana L.*
Black cherry	*Prunus serotina Ehrh.*
Walnut	*Juglans nigra L.*
Butternut	*Juglans cinerea L.*
Hickory	*Carya ovata (Mill.) K. Koch* *Carya cordiformis (Wang) K. Koch* *Carya tomentosa Nutt.* *Carya glabra (Mill.)*

Table 16. — *Volume of the primary growing stock in cubic feet per acre.*
Niagara Section — 1957

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White pine	4″–9″	18.7	15.9	9.9	9.8	7.8	4.6	....
	10″ up	120.7	102.8	64.3	159.4	126.0	75.5	....
White spruce	4″–9″	3.0	2.5	1.6	68.0	53.8	32.2	....
	10″ up	13.2	11.3	7.0	34.6	27.3	16.4	....
Black spruce	4″–9″	....	....	....	16.6	13.2	7.9	....
	10″ up	....	....	....	....	....	....	....
Balsam fir	4″–9″	35.0	29.8	18.6	208.2	164.7	98.6	....
	10″ up	20.1	17.1	10.7	24.7	19.5	11.7	....
Hemlock	4″–9″	127.8	108.8	68.0	11.5	9.1	5.4	....
	10″ up	361.7	307.9	192.5	38.4	30.4	18.2	....
White cedar	4″–9″	682.1	580.7	362.9	1039.6	822.2	492.2	....
	10″ up	861.1	733.0	458.2	205.5	162.5	97.3	....
Larch	4″–9″	0.7	0.6	0.4	61.0	48.3	28.9	....
	10″ up	5.8	4.9	3.1	....	....	....	....
Total Conifers	4″–9″	867.3	738.3	461.4	1414.7	1119.1	669.8	....
	10″ up	1382.6	1177.0	735.8	462.6	365.7	219.1	....
Sugar maple	4″–9″	10.2	8.7	5.4	1.7	1.4	0.8	....
	10″ up	151.9	129.3	80.9	20.5	16.1	9.7	....
Soft maple	4″–9″	8.7	7.4	4.6	11.2	8.8	5.3	....
	10″ up	46.4	39.5	24.7	....	....	....	....
White birch	4″–9″	16.5	14.0	8.8	104.7	82.8	49.6	....
	10″ up	19.2	16.4	10.2	67.2	53.2	31.8	....
Yellow birch	4″–9″	35.3	30.1	18.8	44.1	34.9	20.9	....
	10″ up	120.3	102.4	64.0	50.2	39.7	23.7	....
Beech	4″–9″	4.9	4.2	2.6	....	....	....	....
	10″ up	131.3	111.7	69.9	27.7	21.9	13.1	....
Elm	4″–9″	15.4	13.1	8.2	53.7	42.4	25.4	....
	10″ up	221.3	188.4	117.7	170.9	135.2	81.0	....
Ironwood	4″–9″	7.1	6.1	3.8	....	....	....	....
	10″ up	9.1	7.7	4.8	....	....	....	....
Red oak	4″–9″	....	....	....	....	....	....	....
	10″ up	6.5	5.5	3.4	....	....	....	....
White oak	4″–9″	....	....	....	....	....	....	....
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar	4″–9″	13.0	11.0	6.9	163.0	128.9	77.2	....
	10″ up	61.6	52.5	32.8	167.0	132.0	79.1	....
Black ash	4″–9″	12.0	10.2	6.4	1.9	1.5	0.9	....
	10″ up	4.2	3.6	2.2	3.6	2.8	1.7	....
White ash	4″–9″	0.9	0.8	0.5	....	....	....	....
	10″ up	5.6	4.7	3.0	....	....	....	....
Basswood	4″–9″	3.2	2.7	1.7	....	....	....	....
	10″ up	81.1	69.1	43.1	....	....	....	....
Black cherry	4″–9″	0.2	0.2	0.1	3.2	2.6	1.5	....
	10″ up	3.0	2.6	1.6	5.1	4.0	2.4	....
Total Hardwoods	4″–9″	127.4	108.5	67.8	383.5	303.3	181.6	....
	10″ up	864.7	736.2	460.0	512.2	404.9	242.5	....
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1798.2	1422.4	851.4	....
	10″ up	2247.3	1913.2	1195.8	974.8	770.6	461.6	....
TOTAL 4″ UP		3242.0	2760.0	1725.0	2773.0	2193.0	1313.0	....
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	....	....	....	2.3	1.8	1.1	5.0
	10″ up	....	....	....	9.4	7.4	4.4	14.7
Total Conifers	4″–9″	....	....	....	2.3	1.8	1.1	5.0
	10″ up	....	....	....	9.4	7.4	4.4	14.7

TABLE 16. — (*Cont'd*)

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Sugar maple	4″–9″	88.7	69.8	41.7	96.4	76.3	45.4	104.3
	10″ up	406.7	320.1	191.3	60.4	47.7	28.4	183.8
Soft maple	4″–9″	103.2	81.2	48.5	168.6	133.5	79.4	137.8
	10″ up	763.7	601.1	359.3	147.2	116.4	69.2	325.7
White birch	4″–9″	....	....	....	10.2	8.0	4.8	....
	10″ up	....	....	....	1.5	1.2	0.7	
Yellow birch	4″–9″	9.7	7.6	4.6	18.4	14.6	8.7	14.1
	10″ up	15.1	11.9	7.1	7.3	5.8	3.4	14.2
Beech	4″–9″	54.1	42.6	25.4	75.4	59.6	35.5	59.3
	10″ up	292.6	230.3	137.7	86.1	68.0	40.5	143.1
Elm	4″–9″	198.9	156.6	93.6	310.6	245.6	146.1	205.9
	10″ up	1101.3	866.8	518.1	325.9	257.6	153.3	559.2
Ironwood	4″–9″	21.3	16.8	10.1	29.1	22.9	13.7	22.8
	10″ up	3.5	2.7	1.6	1.3	1.1	0.6	3.7
Red oak	4″–9″	17.6	13.8	8.3	75.0	59.3	35.3	38.7
	10″ up	139.3	109.7	65.5	77.1	60.9	36.3	122.9
White oak	4″–9″	35.7	28.1	16.8	64.8	51.2	30.5	48.0
	10″ up	141.8	111.6	66.7	68.6	54.2	32.3	104.1
Poplar	4″–9″	27.5	21.6	12.9	102.4	80.9	48.2	18.1
	10″ up	71.6	56.4	33.7	49.7	39.3	23.4	25.8
Black ash	4″–9″	13.0	10.2	6.1	27.5	21.7	12.9	13.5
	10″ up	7.6	6.0	3.6	5.3	4.2	2.5	9.3
White ash	4″–9″	75.9	59.8	35.7	133.9	105.8	63.0	69.0
	10″ up	217.2	170.9	102.2	90.7	71.8	42.7	141.0
Basswood	4″–9″	28.3	22.2	13.3	45.2	35.7	21.2	20.6
	10″ up	145.1	114.3	68.3	55.4	43.9	26.1	77.3
Black cherry	4″–9″	12.6	9.9	5.9	32.2	25.4	15.1	17.0
	10″ up	32.8	25.8	15.4	24.0	19.0	11.3	27.8
Butternut	4″–9″	....	....	....	....	....		3.2
	10″ up	....	....	....	....	....	....	8.3
Hickory	4″–9″	47.8	37.6	22.5	98.6	78.0	46.4	48.4
	10″ up	55.4	43.6	26.1	39.5	31.2	18.6	45.9
TOTAL HARDWOODS	4″–9″	734.3	577.8	345.4	1288.3	1018.5	606.2	820.7
	10″ up	3393.7	2671.2	1596.6	1040.0	822.3	489.3	1792.1
GRAND TOTAL	4″–9″	734.3	577.8	345.4	1290.6	1020.3	607.3	825.7
	10″ up	3393.7	2671.2	1596.6	1049.4	829.7	493.7	1806.8
TOTAL 4″ UP		4128.0	3249.0	1942.0	2340.0	1850.0	1101.0	2632.5
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	60.7	48.1	28.7	78.2	62.1	37.7	103.4
	10″ up	670.5	531.1	317.3	90.6	72.1	43.7	382.5
Red pine	4″–9″	....	....	....	....	....	....	77.1
	10″ up	....	....	....	....	....	....	134.0
Balsam fir	4″–9″	....	....	....	2.7	2.1	1.3	
	10″ up							
Hemlock	4″–9″	148.5	117.7	70.3	42.4	33.7	20.4	61.5
	10″ up	257.3	203.8	121.7	80.9	64.3	39.0	162.2
White cedar	4″–9″	113.9	90.2	53.9	351.2	279.1	169.3	95.0
	10″ up	142.0	112.5	67.2	80.3	63.8	38.7	42.1
Larch	4″–9″	4.2	3.3	2.0	58.2	46.2	28.1	
	10″ up	3.1	2.5	1.5	24.9	19.8	12.0	
TOTAL CONIFERS	4″–9″	327.3	259.3	154.9	532.7	423.2	256.8	337.0
	10″ up	1072.9	849.9	507.7	276.7	220.0	133.4	720.8
Sugar maple	4″–9″	25.6	20.2	12.1	8.0	6.4	3.9	76.7
	10″ up	142.6	113.0	67.5	....	....	....	81.0
Soft maple	4″–9″	105.7	83.7	50.0	162.1	128.9	78.1	109.0
	10″ up	150.2	119.0	71.1	213.1	169.4	102.8	151.4

TABLE 16. — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*)			MIXEDWOODS IMMATURE (M-II) (*Cont'd*)			MIXEDWOODS ALL-AGED (*Cont'd*)
		DENSITY CLASS			DENSITY CLASS			
		1	2	3	1	2	3	
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White birch	4″–9″	7.5	6.0	3.5	114.2	90.8	55.1	35.1
	10″ up	18.1	14.3	8.6	17.1	13.6	8.2	18.0
Yellow birch	4″–9″	87.4	69.2	41.4	127.2	101.1	61.3	41.6
	10″ up	106.4	84.3	50.3	47.0	37.4	22.7	24.4
Beech	4″–9″	49.0	38.8	23.2	4.0	3.2	1.9	22.7
	10″ up	327.6	259.4	155.0	14.8	11.7	7.1	158.3
Elm	4″–9″	54.9	43.5	26.0	192.0	152.5	92.5	96.4
	10″ up	467.9	370.6	221.3	435.1	345.9	209.8	351.3
Ironwood	4″–9″	3.7	2.9	1.7	....	....	....	11.0
	10″ up	....	....	....	....	....	....	....
Red oak	4″–9″	6.6	5.2	3.1	14.6	11.6	7.0	63.2
	10″ up	198.1	157.0	93.8	6.8	5.4	3.3	167.5
White oak	4″–9″	51.9	41.1	24.5	20.5	16.3	9.9	84.8
	10″ up	251.6	199.2	119.0	6.3	5.0	3.0	26.5
Poplar	4″–9″	10.4	8.2	4.9	218.0	173.3	105.1	18.1
	10″ up	37.1	29.5	17.6	133.1	105.7	64.2	29.7
Black ash	4″–9″	21.7	17.2	10.3	67.7	53.8	32.7	29.3
	10″ up	11.2	8.9	5.3	7.3	5.8	3.5	2.1
White ash	4″–9″	3.4	2.7	1.6	5.4	4.3	2.6	11.3
	10″ up	18.5	14.7	8.8	....	....	....	16.9
Basswood	4″–9″	6.9	5.5	3.3	14.0	11.1	6.7	13.1
	10″ up	26.0	20.6	12.3	12.8	10.2	6.2	45.6
Black cherry	4″–9″	14.5	11.5	6.9	24.1	19.1	11.6	6.9
	10″ up	51.3	40.6	24.3	5.4	4.3	2.6	26.6
Butternut	4″–9″	....	....	....	....	....	....	0.6
	10″ up	....	....	....	....	....	....	11.1
Hickory	4″–9″	....	....	....	....	....	....	9.0
	10″ up	....	....	....	....	....	....	9.3
TOTAL HARDWOODS	4″–9″	449.2	355.7	212.5	971.8	772.4	468.4	628.8
	10″ up	1806.6	1431.1	854.9	898.8	714.4	433.4	1119.7
GRAND TOTAL	4″–9″	776.5	615.0	367.4	1504.5	1195.6	725.2	965.8
	10″ up	2879.5	2281.0	1362.6	1175.5	934.4	566.8	1840.5
TOTAL 4″ UP		3656.0	2896.0	1730.0	2680.0	2130.0	1292.0	2806.3

TABLE 17. — *Volume of the primary growing stock in cubic feet per acre. Huron Section — 1957*

SPECIES	D.B.H.	CONIFEROUS MATURE (C-I)			CONIFEROUS IMMATURE (C-II)			ALL-AGED
		Density Class			Density Class			
		1	2	3	1	2	3	
		cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.	cu. ft.
White pine	4″–9″	18.7	15.9	9.9	9.8	7.8	4.6	
	10″ up	120.7	102.8	64.3	159.4	126.0	75.5	
White spruce	4″–9″	3.0	2.5	1.6	68.0	53.8	32.2	
	10″ up	13.2	11.3	7.0	34.6	27.3	16.4	
Black spruce	4″–9″	....	....	....	16.6	13.2	7.9	
	10″ up	....	....	....	....	....	....	
Balsam fir	4″–9″	35.0	29.8	18.6	208.2	164.7	98.6	....
	10″ up	20.1	17.1	10.7	24.7	19.5	11.7	....
Hemlock	4″–9″	127.8	108.8	68.0	11.5	9.1	5.4	
	10″ up	361.7	307.9	192.5	38.4	30.4	18.2	
White cedar	4″–9″	682.1	580.7	362.9	1039.6	822.2	492.2	....
	10″ up	861.1	733.0	458.2	205.5	162.5	97.3	....
Larch	4″–9″	0.7	0.6	0.4	61.0	48.3	28.9	....
	10″ up	5.8	4.9	3.1	....	....	....	....
TOTAL CONIFERS	4″–9″	867.3	738.3	461.4	1414.7	1119.1	669.8	....
	10″ up	1382.6	1177.0	735.8	462.6	365.7	219.1	
Sugar maple	4″–9″	10.2	8.7	5.4	1.7	1.4	0.8	
	10″ up	151.9	129.3	80.9	20.5	16.1	9.7	....
Soft maple	4″–9″	8.7	7.4	4.6	11.2	8.8	5.3	....
	10″ up	46.4	39.5	24.7	....	....	....	
White birch	4″–9″	16.5	14.0	8.8	104.7	82.8	49.6	
	10″ up	19.2	16.4	10.2	67.2	53.2	31.8	....
Yellow birch	4″–9″	35.3	30.1	18.8	44.1	34.9	20.9	....
	10″ up	120.3	102.4	64.0	50.2	39.7	23.7	
Beech	4″–9″	4.9	4.2	2.6	....	....	....	....
	10″ up	131.3	111.7	69.9	27.7	21.9	13.1	....
Elm	4″–9″	15.4	13.1	8.2	53.7	42.4	25.4	....
	10″ up	221.3	188.4	117.7	170.9	135.2	81.0	....
Ironwood	4″–9″	7.1	6.1	3.8	....			
	10″ up	9.1	7.7	4.8	....	....	....	....
Red oak	4″–9″	....	....	....	....	....	....	
	10″ up	6.5	5.5	3.4	....	....	....	
White oak	4″–9″	....	....	....	....	....	....	
	10″ up	3.2	2.8	1.7	....	....	....	....
Poplar	4″–9″	13.0	11.0	6.9	163.0	128.9	77.2	....
	10″ up	61.6	52.5	32.8	167.0	132.0	79.1	....
Black ash	4″–9″	12.0	10.2	6.4	1.9	1.5	0.9	
	10″ up	4.2	3.6	2.2	3.6	2.8	1.7	
White ash	4″–9″	0.9	0.8	0.5	....	....	....	
	10″ up	5.6	4.7	3.0	....	....	....	
Basswood	4″–9″	3.2	2.7	1.7	....	....	....	
	10″ up	81.1	69.1	43.1	....	....	....	
Black cherry	4″–9″	0.2	0.2	0.1	3.2	2.6	1.5	
	10″ up	3.0	2.6	1.6	5.1	4.0	2.4	
TOTAL HARDWOODS	4″–9″	127.4	108.5	67.8	383.5	303.3	181.6	
	10″ up	864.7	736.2	460.0	512.2	404.9	242.5	
GRAND TOTAL	4″–9″	994.7	846.8	529.2	1798.2	1422.4	851.4	
	10″ up	2247.3	1913.2	1195.8	974.8	770.6	461.6	
TOTAL 4″ UP		3242.0	2760.0	1725.0	2773.0	2193.0	1313.0	
		HARDWOODS MATURE (H-I)			HARDWOODS IMMATURE (H-II)			HARDWOODS ALL-AGED
White pine	4″–9″	....	....	....	1.8	1.5	0.9	
	10″ up	....	....	....	3.1	2.4	1.4	
Balsam fir	4″–9″	....	....	....	2.5	2.0	1.2	
	10″ up							

SPECIES	D.B.H.	HARDWOODS MATURE (H-I) (*Cont'd*) Density Class 1	2	3	HARDWOODS IMMATURE (H-II) (*Cont'd*) Density Class 1	2	3	HARDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
Hemlock	4″–9″	12.1	9.6	5.7	23.8	18.8	11.2	21.2
	10″ up	46.0	36.4	21.5	28.1	22.2	13.2	42.7
White cedar	4″–9″	4.0	3.2	1.9	24.8	19.5	11.7	7.2
	10″ up	3.3	2.6	1.5	9.8	7.8	4.6	8.3
TOTAL CONIFERS	4″–9″	16.1	12.8	7.6	52.9	41.8	25.0	28.4
	10″ up	49.3	39.0	23.0	41.0	32.4	19.2	51.0
Sugar maple	4″–9″	260.7	206.4	122.1	366.4	289.3	172.1	299.4
	10″ up	1042.8	825.7	488.2	177.2	139.9	83.3	375.5
Soft maple	4″–9″	69.1	54.7	32.4	154.5	122.0	72.6	153.7
	10″ up	337.6	267.3	158.0	112.4	88.7	52.8	274.1
White birch	4″–9″	....	....	....	30.4	24.0	14.3	9.7
	10″ up	....	....	....	4.2	3.3	2.0	5.3
Yellow birch	4″–9″	20.7	16.4	9.7	25.4	20.1	12.0	28.1
	10″ up	37.4	29.6	17.5	14.1	11.1	6.6	30.2
Beech	4″–9″	26.4	20.9	12.4	21.8	17.2	10.2	24.2
	10″ up	547.3	433.4	256.2	49.9	39.4	23.5	126.1
Elm	4″–9″	110.1	87.2	51.6	278.5	219.9	130.8	190.4
	10″ up	699.6	553.9	327.5	341.8	269.8	160.6	544.1
Ironwood	4″–9″	15.3	12.1	7.2	23.7	18.7	11.1	19.0
	10″ up	10.1	8.0	4.7	1.0	0.8	0.5	4.4
Red oak	4″–9″	....	....	....	....	....	....	6.2
	10″ up	....	....	....	....	....	....	34.2
White oak	4″–9″	....	....	....	9.7	7.6	4.6	9.0
	10″ up	....	....	....	5.1	4.1	2.4	12.4
Poplar	4″–9″	7.0	5.5	3.3	175.9	138.8	82.6	38.4
	10″ up	14.8	11.7	6.9	56.4	44.6	26.5	49.5
Black ash	4″–9″	22.1	17.5	10.4	74.4	58.8	34.8	41.6
	10″ up	36.0	28.5	16.8	19.5	15.4	9.2	29.2
White ash	4″–9″	16.5	13.0	7.7	82.1	64.8	38.6	40.2
	10″ up	85.2	67.5	39.9	58.7	46.4	27.6	98.1
Basswood	4″–9″	16.8	13.3	7.9	61.4	48.5	28.9	27.7
	10″ up	143.0	113.2	66.9	79.4	62.7	37.3	116.1
Black cherry	4″–9″	10.3	8.1	4.8	59.1	46.6	27.7	22.7
	10″ up	18.7	14.9	8.8	20.0	15.8	9.4	31.6
Butternut	4″–9″	....	....	....	....	....	....	....
	10″ up	3.6	2.9	1.7	....	....	....	....
Walnut	4″–9″	....	....	....	....	....	....	....
	10″ up	3.6	2.9	1.7	....	....	....	....
Hickory	4″–9″	3.4	2.7	1.6	54.0	42.6	25.4	15.9
	10″ up	7.5	5.9	3.5	20.1	15.9	9.4	15.7
TOTAL HARDWOODS	4″–9″	578.4	457.8	271.1	1417.3	1118.9	665.7	926.2
	10″ up	2987.2	2365.4	1398.3	959.8	757.9	451.1	1746.5
GRAND TOTAL	4″–9″	594.5	470.6	278.7	1470.2	1160.7	690.7	954.6
	10″ up	3036.5	2404.4	1421.3	1000.8	790.3	470.3	1797.5
TOTAL 4″ UP		3631.0	2875.0	1700.0	2471.0	1951.0	1161.0	2752.1
		MIXEDWOODS MATURE (M-I)			MIXEDWOODS IMMATURE (M-II)			MIXEDWOODS ALL-AGED
White pine	4″–9″	13.3	10.5	6.3	1.7	1.3	0.8	0.5
	10″ up	124.1	98.0	59.0	17.1	13.5	8.2	22.8
White spruce	4″–9″	....	....	....	14.7	11.5	7.0	12.6
	10″ up	....	....	....	28.4	22.4	13.7	28.8
Balsam fir	4″–9″	16.2	12.8	7.7	70.3	55.4	33.7	26.2
	10″ up	....	....	....	10.4	8.2	5.0	4.3
Hemlock	4″–9″	111.1	87.7	52.8	62.4	49.2	29.9	55.1
	10″ up	357.5	282.4	169.9	45.2	35.6	21.7	123.1

TABLE 17 — (*Cont'd*)

SPECIES	D.B.H.	MIXEDWOODS MATURE (M-I) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS IMMATURE (M-II) (*Cont'd*) Density Class 1	2	3	MIXEDWOODS ALL-AGED (*Cont'd*)
		cu. ft.	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*	*cu. ft.*
White cedar	4″–9″	294.9	232.9	140.1	512.7	404.1	245.9	208.9
	10″ up	294.9	233.0	140.2	141.2	111.3	67.8	150.0
Larch	4″–9″	1.7	1.4	0.8	50.3	39.7	24.1	28.0
	10″ up	6.4	5.0	3.0	14.3	11.2	6.9	15.9
TOTAL CONIFERS	4″–9″	437.2	345.3	207.7	712.1	561.2	341.4	331.3
	10″ up	782.9	618.4	372.1	256.6	202.2	123.3	344.9
Sugar maple	4″–9″	50.9	40.2	24.2	40.3	31.7	19.3	77.4
	10″ up	203.6	160.8	96.8	40.4	31.9	19.4	130.0
Soft maple	4″–9″	78.4	61.9	37.2	80.4	63.4	38.6	36.1
	10″ up	454.9	359.3	216.2	86.4	68.1	41.4	48.1
White birch	4″–9″	29.1	23.0	13.8	124.3	98.0	59.6	40.0
	10″ up	19.4	15.3	9.2	42.5	33.5	20.4	33.1
Yellow birch	4″–9″	80.1	63.3	38.1	89.0	70.2	42.7	74.4
	10″ up	166.3	131.4	79.0	75.2	59.3	36.1	89.3
Beech	4″–9″	6.4	5.0	3.0	2.2	1.8	1.1	8.4
	10″ up	199.6	157.7	94.9	30.1	23.7	14.4	113.1
Elm	4″–9″	92.4	73.0	43.9	98.1	77.3	47.1	79.1
	10″ up	1034.8	817.3	491.9	243.7	192.1	116.9	615.8
Ironwood	4″–9″	6.8	5.4	3.2	4.6	3.5	2.2	7.3
	10″ up	9.4	7.4	4.5	0.8	0.7	0.4	
Red oak	4″–9″	....	....	....	....	....	....	
	10″ up	4.0	3.2	1.9	....	....	....	
Poplar	4″–9″	25.6	20.2	12.2	342.4	269.9	164.2	95.2
	10″ up	107.7	85.1	51.2	246.9	194.6	118.5	216.9
Black ash	4″–9″	61.0	48.2	29.0	51.8	40.9	24.8	62.2
	10″ up	44.0	34.8	20.9	2.0	1.6	1.0	12.0
White ash	4″–9″	10.0	7.9	4.8	20.2	15.9	9.7	8.3
	10″ up	26.4	20.8	12.5	71.3	56.2	34.2	16.3
Basswood	4″–9″	11.8	9.3	5.6	6.4	5.0	3.1	38.6
	10″ up	44.8	35.3	21.3	7.1	5.6	3.5	142.2
Black cherry	4″–9″	11.4	9.0	5.4	7.3	5.8	3.5	8.0
	10″ up	37.1	29.3	17.6	8.9	6.9	4.2	5.2
Hickory	4″–9″	....	....	....	....	....	....	3.1
	10″ up	4.0	3.2	1.9				
TOTAL HARDWOODS	4″–9″	463.9	366.4	220.4	867.0	683.4	415.9	538.1
	10″ up	2356.0	1860.9	1119.8	855.3	674.2	410.4	1422.0
GRAND TOTAL	4″–9″	901.1	711.7	428.1	1579.1	1244.6	757.3	869.4
	10″ up	3138.9	2479.3	1491.9	1111.9	876.4	533.7	1766.9
TOTAL 4″ UP		4040.0	3191.0	1920.0	2691.0	2121.0	1291.0	2636.3

Notes

Notes

Notes

Hon. J. W. Spooner
Minister

F. A. MacDougall
Deputy Minister

Report No. 24

Normal Yield Tables

for Black Spruce, Jack Pine, Aspen and White Birch in Northern Ontario

- 1956 -

Division of Timber Management
Ontario Department of Lands and Forests

Normal Yield Tables

for Black Spruce, Jack Pine, Aspen and White Birch

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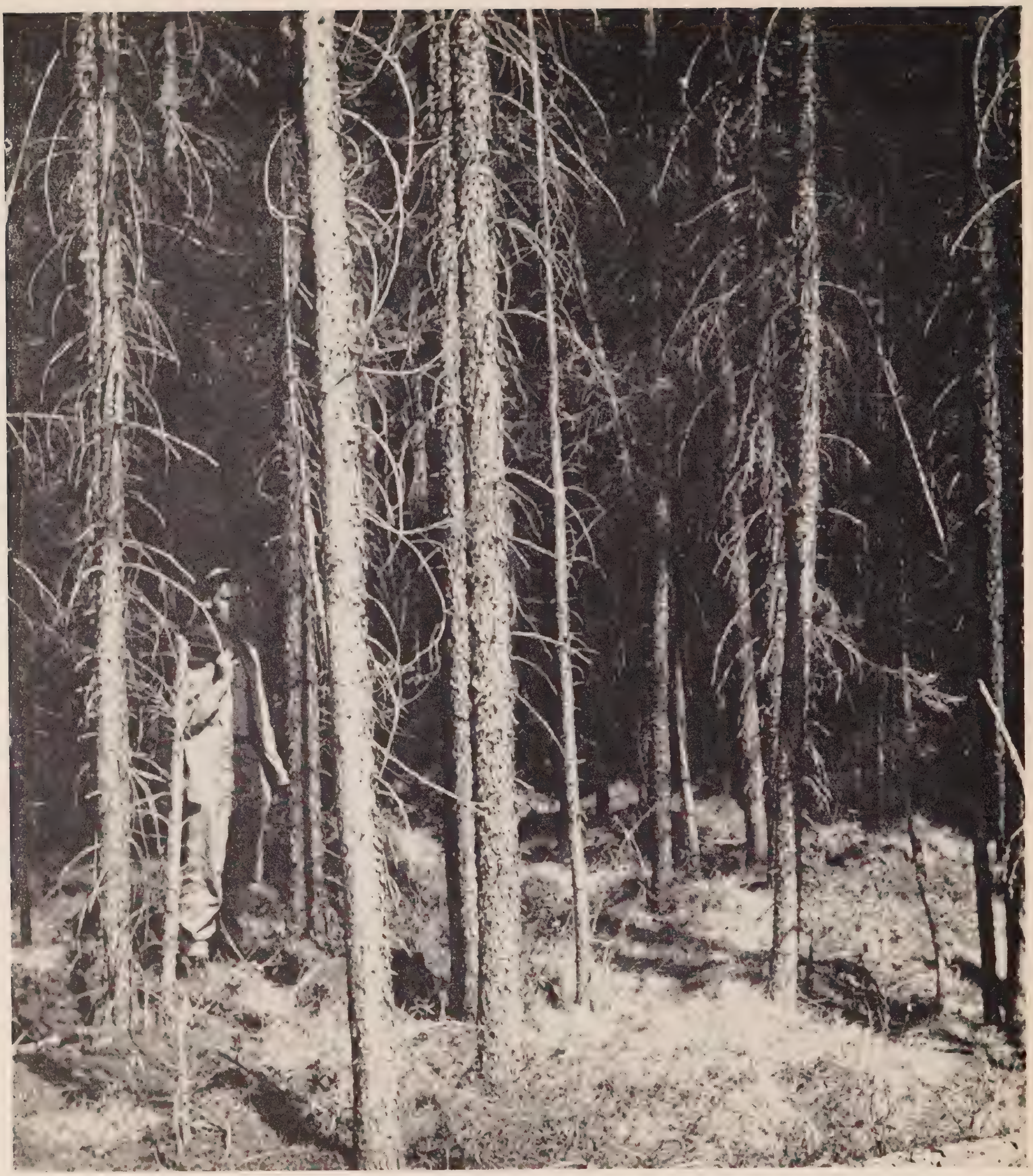
Report No. 24

by
W. L. PLONSKI

Division of Timber Management
Ontario Department of Lands and Forests



This black spruce stand, on site-class 1.5, shows 35.8 feet average height at the age of 59 years. Basal area of 108.6 sq. ft. indicates stocking 0.8, which is below the normal stocking 1.0. Gross total volume per acre is 1,840 cu. ft. and the annual current increment is 39.5 cu. ft. The gross merchantable volume of 710 cu. ft., or 8.4 cords per acre, is currently increasing by 44.0 cu. ft. per year, indicating a growth rate of 6.2 per cent per annum.

CONTENTS

A 56-year-old jack pine stand with an average height of 50.0 feet. The site class is 2.3 and is slightly below the average growth condition. With basal area of 105.9 sq. ft. per acre, the stand is fully stocked. The gross total volume per acre is 2,480 cu. ft. and increases, at this age, by 27.1 cu. ft. annually. At the same time the gross merchantable volume of 1,898 cu. ft. grows by 41.3 cu. ft., or at a rate of 2.18 per cent.

INTRODUCTION

• The wood using industry in Ontario, which influences to a large extent the over-all economy of the province, has now expanded to the point where considerable planning is required if the industry is to be assured of an adequate supply of raw material on a long-term basis. Indeed, in order to meet the greatly increased demands for wood, with which we will be faced in two or three decades, and maintain our unique position in world markets, it will be necessary to put the forests of Ontario under intensive management, because future expansion can be based only on a thorough knowledge of what the forest will actually yield, and what it is capable of yielding. The basis for such knowledge is a detailed forest inventory by stands, and data on the development and growth of stands, as opposed to individual trees, thus making it possible to predict yields of wood per acre for several years into the future. In the determination of both detailed inventory by stands, and prediction of the growth of stands, a yield table for each species is an indispensable tool.

• Briefly, a yield table for each species is a tabular statement of the volume per acre of stands on given sites at given ages. These tables are particularly applicable to pure, or almost pure, even-aged stands; and for the most part the forest of Northern Ontario is made up of such stands. More than 80 per cent of the vast woodlands are made up of black spruce, *Picea mariana* (Mill.) BSP., jack pine, *Pinus Banksiana* Lamb., aspen, *Populus tremuloides* Michx., and white birch, *Betula papyrifera* Marsh., and these species tend to grow in pure, even-aged stands because they come in following fire and the clear-cutting operations in general use.

The size and composition of the forest, or growing stock, change yearly as a result of woods operations, other forms of depletion, and of increment. The best forest management considers all these factors and conducts woods and stand improvement operations so that the resulting growing stock is able to produce continually a crop of the highest volume and value. Proper treatment can be achieved only by experience, and therefore it is necessary to assess the results of treatment by periodically re-measuring the growing stock and increment, and re-examining the methods used in harvesting and stand improvement. These periodic appraisals are reflected in the "major revisions" of management plans, which usually occur in 20-year intervals. The use of yield tables secures comparable data for each inventory, whether initial or consecutive, because volume and increment estimates are always carried out in the same manner and computed from the same basic growth and yield data. In addition, the results are accurate enough for most practical purposes, and since sample plots are not required, there is a substantial reduction in cost.

There are two kinds of yield tables: empirical tables, which are constructed from stands of all degrees of stocking as encountered in nature, thus representing the average stocking at the time the tables are made; and normal tables, which are based on stands of optimum stocking and reflect potential productive capacity. Empirical yield tables are suitable for purposes of broad inventory, where volume estimates based upon average conditions are acceptable. However, this use is temporary and not suitable for the long-term, because with the passage of time the average degree of stocking in a forest is subject to considerable change. Furthermore, in good forest management one must eventually deal with individual stands, and in estimating the volume and predicting the growth of an individual stand, a table representing average stocking is not reliable.

Optimum, or normal, stocking does not change, and therefore tables dealing with these conditions have a continuing use, and are particularly valuable in planning the long-term, periodic treatments of the growing stock which are inherent in forest management. Also, because the normal growing stock and increment can be determined in addition to the actual yield, a standard of optimum production per acre for which to strive is provided, and at the same time a measure of the abnormality of a stand at any period in its development. Consequently the effect of cutting on the growing stock can be kept under close observation. Furthermore, the normal growing stock and increment derived from normal tables allow the use of any method applicable to clear-cutting systems for the calculation of allowable cuts.

The purpose of this publication is to present normal yield tables for the four main species of Northern Ontario, and to put particular stress on their application to forest management, namely,

in calculating the volume and increment of individual stands, and the growing stock and increment of a working group. The technique of preparing the tables themselves is presented in general terms, with only sufficient detail to provide a hint of what is involved. The technique employs some aspects of yield table construction which are not in general use, and a detailed description would be too voluminous to be included in this publication.

This 60-year-old black spruce stand has an average height of 40.6 feet, and is therefore on a good site (site-class 1.1). The basal area is 150.1 square feet per acre, and for site-class 1.1 this indicates that the stand is slightly overstocked. The gross total volume 2,918 cubic feet per acre puts on 49.2 cu. ft. annually; gross merchantable volume is 20.4 cords per acre and, at this age, grows at a rate of 2.86 per cent.

CONSTRUCTION OF THE TABLES

Field Methods

● The field work for the project was initiated by the Department of Lands and Forests in 1952, and concluded in 1954. Sampling extended over the areas shown by solid blocks in Fig. 1, which include the Algonquin, Central Transition, Clay Belt, Coastal Plain, Central Plateau, Northern Coniferous, Western Transition, English River and Quetico Ecological Sections as outlined in the Ontario Resources Atlas*. Each block represents a locality in which several sample plots were measured. In all, 546 single-examination sample plots were tallied: 224 in black spruce stands, 181 in jack pine, 82 in aspen, and 59 in white birch stands. Plots were 0.4 acres in area in practically every case, were always rectangular, and usually square (2 x 2 chs.).

Plots were located in pure, fully-stocked, even-aged stands, on topographically uniform sites. To satisfy the stocking requirement, it was essential for the stands to have closed canopies, but at the same time not to be suffering from stagnation.

In each plot, all living trees 0.6 inches d.b.h. and over were tallied, and classified in the tally into main stand and suppressed trees. A minimum of 15

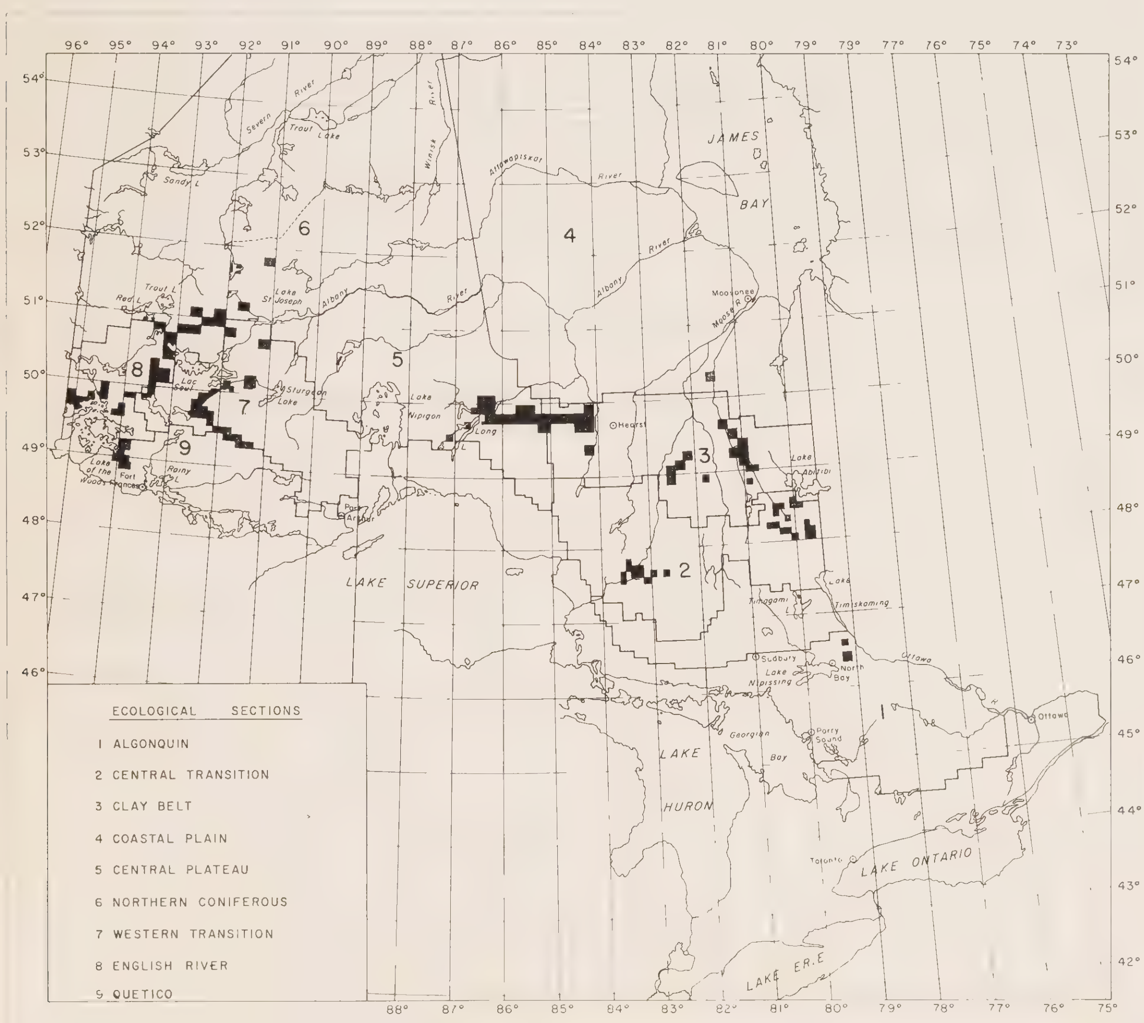


FIG. 1. — *Map of Ontario showing forest ecological sections and the locations of field sampling. Each block represents a locality in which several sample plots were measured.*

* Department of Lands and Forests. Ontario Resources Atlas. Toronto, 1955.

diameter-height measurements were taken to produce a D-H curve for each plot. Also, at least one average-sized tree per plot was felled, measured, and analyzed for height development throughout its life. Data obtained from these trees, as well as from a considerable number of trees felled and measured by the cull survey field parties of the Ontario Dept. of Lands and Forests, have been used to produce standard volume tables by site classes. In all, 1,902 black spruce, 1,336 jack pine, 1,132 aspen and 587 white birch trees were used for this purpose, and the least squares method was adopted to determine the volume equations.

Office Methods

In an earlier investigation* involving a sample of 101,000 Scots pine stands, the writer found that for any species occurring in pure, even-aged stands, the distribution within an age class of number of stands by average stand height forms a normal curve (Fig. 2). This relation holds true only in a forest where cutting operations have been evenly distributed among all sites, or where the forest is natural and undisturbed.

Because the curve is normal, its peak is exactly above the arithmetic mean on the x-axis, which means that the greatest frequency of stands occurs exactly one-half way between the lowest and the highest height development that the area has produced, and thus represents the average stand height. The practical significance of this fundamental relation between stand height and stand frequency is that the average stand height for any species and age class may always be found midway between the lowest and highest values, provided the field sampling has included the lowest and highest stand-height development. Apart from this prerequisite, the actual number of field samples is of secondary importance.

Determination of the average stand height development provides the basis for a division into site classes, which may follow any convenient pattern. In this project three site classes were adopted, located in such a way as to include 45% of the stands in the middle or average site class (site-class 2), and 27.5% each in the poorest and best site classes (Fig. 2). This division into site classes is arbitrary, and is influenced largely by the use of aerial photographs in forest inventory. Under this condition, any system of site-class breakdown must be a compromise between what can be successfully applied to aerial photos and what will provide a meaningful quantitative subdivision of the growing stock.

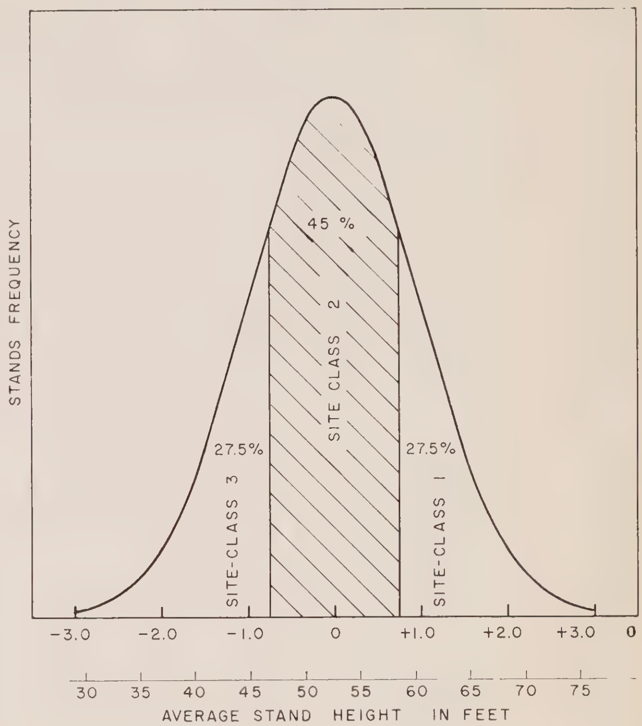


Fig. 2. — *Normal distribution of stands by height in 150-year-old black spruce. Division into three site classes is such that 45% of stands are in site-class 2, and 27.5% each in site-classes 1 and 3.*

The height curves for each species and site class were derived from a stem analysis of average-sized trees rather than from average height by age classes as sampled in the field. This procedure was necessary because of lack of evidence that each age class contained the same variety of growth conditions, and that field work, however carefully conducted, covered satisfactorily the whole range of growth conditions.

In the stem analysis, the age-height curves for each species were constructed and balanced for each of the three site classes. For black spruce, these curves are the dotted lines in Fig. 3. Sampling

* Plonski, Dr. Wladyslaw. Uber Verwendung mancher Elemente der speziellen Bestandesbeschreibung in Herleitung von Ertragstafeln, auf Grund polnischer Erfahrungen. (The use of certain details of stand description in the construction of yield tables, based on experiences in Poland.) 9th Congress of the International Union of Forest Research Institutes, Paper No. 44, Hungary. 1936.

inadequacy is almost always present, and this is revealed by the shape of the normal curve (Fig. 2). It is therefore possible, by knowing the properties of the curve, to determine the true height values if sampling were adequate. Consequently, adjustments in the age-height curves were made where necessary by mathematical and graphical methods in order to obtain the balanced and harmonized final

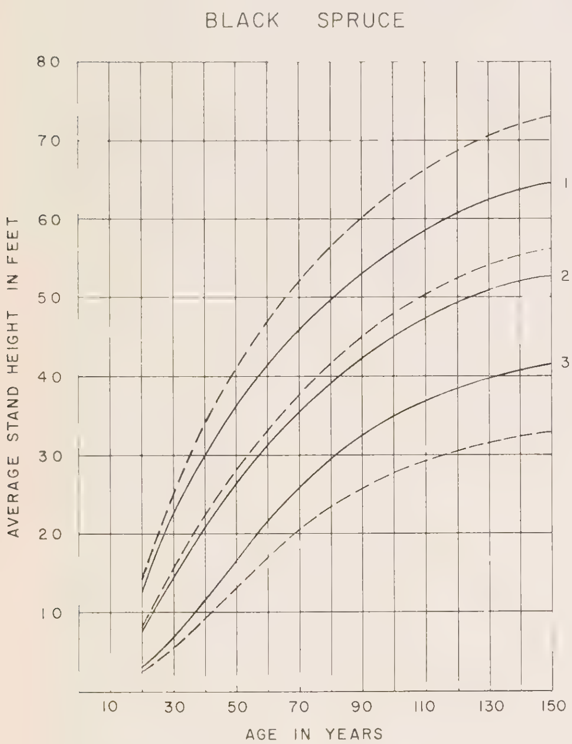


FIG. 3. — *Height of black spruce stands by age for the three site classes. Dotted curves are from stem analysis; solid curves are balanced and harmonized.*

age-height curves (solid lines, Fig. 3). The final age-height curves for each species (Figs. 5, 8, 11, 14) may then be used to determine site class from the height and age of stand.

The curves for basal area, total and merchantable volume, and number of stems per acre were developed principally from correlated data on selected plots for each site class, paying particular attention to individual plots and individual site classes as determined from the final age-height curves. Diagrams showing the development of basal area (Figs. 6, 9, 12, 15), and of gross total volume per acre (Figs. 7, 10, 13, 16), were produced in this way for easy determination of the stocking factor and actual volume per acre.

While the diagrams give only development of stand-height, basal area per acre and gross total volume per acre, the yield tables (Tables 3 to 14) contain other stand characteristics which may prove useful in inventory and planning. These basic data are shown in five-year intervals; most of them were derived from balanced and harmonized basic curves, while some result from calculation alone. For example, figures for current annual increment were taken as one-fifth of the difference between the successive volume figures, the figures for mean annual increment were derived from volume and age, and the average d.b.h. from basal area and number of stems per acre. The volume of trees which become suppressed in five-year periods is shown in the tables opposite the given age, and cumulatively to the given age. This enables computation of the total production, which comprises volume of residual stand plus cumulative volume of suppressed trees.

No appreciable differences in volumetric and other data were found among comparable stands in different ecological sections, e.g., a black spruce stand on site-class 1 has approximately the same features whether it is in the Clay Belt or the Western Transition Section. The important difference among ecological sections is the proportion of one site or another, and this feature is automatically taken care of in the application of the tables. Therefore all data were pooled into consolidated tables for the whole of Northern Ontario.

USE OF THE TABLES IN THE FIELD

Volume and Increment Estimate of a Stand

To estimate the volume per acre and current annual increment from normal yield tables, it is necessary to determine: (1) age of stand, (2) the average height, (3) the site class, and (4) the stocking factor.

1. *Age of Stand*

Any reliable record, or information, may be used. If none is available, then the annual rings should be counted on approximately average-sized trees and allowance made up to the height at which rings are counted.

2. *Average Stand Height*

The mean height of dominant and codominant trees of approximately average d.b.h. is regarded as the average stand height. Height measurements should be taken with a hypsometer on three to five trees and then averaged.

3. *Site Class*

With the average age and stand height known, site class of a stand may be read directly from Figs. 5, 8, 11 or 14, depending on the species under consideration. The x-axis represents the age of stand, and the y-axis the average height of stand. Although readings can be made to a decimal of a site class for detailed inventory purposes, it is generally sufficient to use the nearest even site class, that is, 1, 2 or 3. If for any reason, such as very shallow soil, a site is known to be unfavourable for tree growth over the full rotation period, the site should be classified as site-class 3 even if the present growth, as judged from age and height, indicates a better site class.

4. *Stocking Factor*

The stocking factor expresses the relation of actual volume to normal volume. In practice, however, an expression giving a similar answer is used:

$$\frac{\text{actual basal area per acre}}{\text{normal basal area per acre}}$$

Therefore, to compute the stocking factor of a stand, both the actual and the normal basal area must be determined.

The actual basal area may be estimated by any reliable short-cut method, two of which are outlined here. The first method uses the average distance between trees and the tree of average diameter, which in turn are used to calculate the number of trees per acre and the basal area of the tree of average diameter. The last two factors multiplied together give the basal area per acre.

The number of trees per acre is obtained from the average distance between trees as follows: A direction across the stand is chosen, along which the average conditions are expected, and all neighbouring trees encountered along that direction are tallied and recorded in the conventional manner. The distances between the tallied trees are measured (paced), recorded, and the average distance calculated (Fig. 4). The longest diagonal across the stand

Fig. 4. — *Outline of a stand and a schematic line cruise.*

generally has the best chance of crossing all stand conditions, thus giving the best estimate of the average distance between trees. Once the average distance between trees is known, the number of trees per acre can be read directly from Table 1.

The tree of average diameter is not calculated from a simple arithmetic average of all trees in the stand, but is actually the tree of average basal area.

TABLE 1.

Number of Trees per Acre (N) for Average Spacing in Feet (A.d.)

A.d.	N	A.d.	N	A.d.	N	A.d.	N	A.d.	N
3.0	4840	7.5	774	12.0	302	16.5	160	22.0	90
3.5	3556	8.0	681	12.5	279	17.0	151	23.0	82
4.0	2722	8.5	603	13.0	258	17.5	142	24.0	76
4.5	2151	9.0	538	13.5	239	18.0	134	25.0	70
5.0	1742	9.5	483	14.0	222	18.5	127	26.0	64
5.5	1440	10.0	436	14.5	207	19.0	121	27.0	60
6.0	1210	10.5	395	15.0	194	19.5	115	28.0	56
6.5	1031	11.0	360	15.5	181	20.0	109	29.0	52
7.0	889	11.5	329	16.0	170	21.0	99	30.0	48

The method of calculating the tree of average basal area is based on the fact that in typical normal diameter distributions, it is usually found that about 60 per cent of all tallied trees are smaller than the average tree, and 40 per cent are greater. Therefore, the tree of average d.b.h. is found by counting trees from the smallest diameter class to the diameter where the 60 per cent tree is located. The diameter so obtained is rounded off to the nearest one-half inch and the basal area taken from Table 2. The number of trees per acre multiplied by the tree of average basal area gives the actual stand basal area.

TABLE 2

d.b.h. in.	b.a. sq. ft.	d.b.h. in.	b.a. sq. ft.	d.b.h. in.	b.a. sq. ft.	d.b.h. in.	b.a. sq. ft.	d.b.h. in.	b.a. sq. ft.
2.0	.0218	4.5	.1104	7.0	.2673	9.5	.4922	12.0	.7854
2.5	.0341	5.0	.1364	7.5	.3068	10.0	.5454	12.5	.8522
3.0	.0491	5.5	.1650	8.0	.3491	10.5	.6013	13.0	.9218
3.5	.0668	6.0	.1963	8.5	.3941	11.0	.6600	13.5	.9940
4.0	.0873	6.5	.2304	9.0	.4418	11.5	.7213	14.0	1.0690

The second method of calculating stand basal area is based on a technique developed in Europe by Bitterlich and recently introduced to America*. Basal area is derived by counting trees whose d.b.h. is equal to or greater than that seen within a fixed angle. To do this, a simple instrument is constructed from a stick 33 inches long, with a peephole mounted on one end and a one-inch crossarm on the other. Looking through the peephole, the cruiser makes a 360° sweep from one or more stations in a stand, and counts all trees whose d.b.h. appears equal to or greater than the limits of the crossarm. The number of trees so counted from each station, and multiplied by 10, gives the basal area in square feet per acre.

It should be emphasized that estimating stocking by the basal area method is largely a matter of experience in the field. Consequently, a training period is essential, during which the cruiser will determine the actual basal area of stands encountered, and compute in the field a stocking factor for each stand. Thus he will see stands in various conditions and gain experience in ocular estimating, which is the ultimate goal in the field procedure for estimating stocking in inventory work.

Determination of the preceding four stand factors allows a direct calculation of the stand volume and current annual increment. Normal volume is read from the appropriate site-class table, for the stand age, and this volume is then multiplied by the degree of stocking. The result is the actual cubic foot volume per acre of the stand, expressed both as gross total and as merchantable volume. The increment is calculated in the same way, that is, by reading from the table the normal increment for the stand age and then multiplying the normal increment figure by stocking.

Where site class is read to a decimal, and age is given to the exact number of years, Figs. 7, 10, 13 and 16 (volume per acre) may be used. For any given age, marked on the x-axis, a vertical line is traced up to the intersection with the exact stand-height curve, and the normal volume read on the y-axis. The actual volume is obtained by multiplying the normal volume by the degree of stocking.

The complete procedure, outlined above, is illustrated specifically by the following example:

An estimate of volume and annual current increment is required for a black spruce stand 100 years old, 45 feet high and 185 acres in area.

Actual basal area. The first method outlined above was chosen to determine the actual basal area and stocking. Across the stand 145 distances between neighbouring trees were measured, totaling 1,176 feet. Therefore, the average distance is 1,176 ÷ 145 = 8 feet, and from Table 1 the average number of trees per acre for 8-foot spacing is 681.

The d.b.h. of each tree encountered on the cruising line was measured and the following tally obtained:

Diam.-class:	3	4	5	6	7	8	9	10	11	Total
Number of trees:	9	52	44	28	8	2	1	1	1	146

* Grosenbaugh, L. R. Plotless timber estimates — new, fast, easy. J. Forestry, 50 (1): 32-37, 1952.

Sixty per cent of 146 trees, that is, 88 trees, were counted from the smallest d.b.h. class (at 3 inches d.b.h. — 9 trees, at 4 inches — 52, and the balance 27 trees from the 5-inch class) until the required 88 trees were obtained. In the 5-inch class, actually including trees from 4.6 inches to 5.5 inches, there are 44 trees. If our balance were 22 trees, that is, half of the 44 trees shown in the 5-inch class, then it could have been assumed that the average tree falls exactly in the midpoint of the class, that is, 5.0 inches even. However, in our example the balance is made of 27 trees, and therefore the tree of average basal area has a diameter of 5.2 inches. For practical purposes, the average d.b.h. is taken to the nearest half-inch class, which in this example is 5.0 inches, and the corresponding basal area is 0.1364 square feet.

With the number of trees per acre and the average basal area known, the actual basal area per acre of the stand is: 681 trees x 0.1364 sq. ft. = 92.9 sq. ft.

Normal basal area. To use the proper site-class table, the site class of the stand should be determined first. This is read directly from Fig. 5, which for age 100 years and height 45 ft. gives site-class 2.0. From the site-class 2 table for black spruce (Table 4), the normal basal area for age 100 is 157.3 sq. ft.

Stocking. With the actual basal area 92.9 sq. ft. and the normal 157.3 sq. ft., the stocking factor is:

$$\frac{92.9}{157.3} = 0.6$$

Actual volume and increment. From Table 4, the gross total normal volume per acre for a 100-year-old stand is found to be 3,384 cubic feet, the annual current increment 23.8 cu. ft., and the gross merchantable volume 2,085 cu. ft. per acre.

Reducing these normal data by the stocking factor, the actual figures per acre are:

Gross total volume
3,384 × 0.6 = 2,030 cu. ft.

Current annual increment
23.8 × 0.6 = 14.3 cu. ft.

Gross merchantable
2,085 × 0.6 = 1,251 cu. ft., or 14.7 cords.

For the whole stand, on 185 acres, the estimate would read:

Gross total volume
2,030 × 185 = 375,550 cu. ft.

Current annual increment
14.3 × 185 = 2,646 cu. ft.

Gross merchantable volume
1,251 × 185 = 231,435 cu. ft., or 2,723 cords.

The procedure illustrated by the preceding example gives good results for ordinary inventory work. If, however, a greater accuracy is required than that usually adopted, the following procedure should be followed:

1. The site class read to a decimal;
2. The actual stand basal area determined from the exact average d.b.h. and number of trees;
3. The normal basal area determined by interpolation in the tables to the exact site-class value (Figs. 6, 9, 12 or 15 may also be used);
4. The normal volume also obtained by interpolation as in (3), or read directly from Figs. 7, 10, 13 or 16, thus saving time.

In forest management, inventories are usually compiled by working groups and, therefore, to obtain the actual growing stock and increment of a working group, the volume as well as increment of all stands making up the working group are added together.

Normal Growing Stock and Increment of a Working Group

The immediate need for knowing the normal growing stock and normal increment of a working group is to enable a calculation of the allowable cut. In the longer term, the normal growing stock will be a great help in assessing the effect of cutting, through the inventory carried out every 20 years.

Normal Growing Stock. To determine the volume of normal growing stock for a working group, before the annual cut has been taken out, the following formula may be used:

$$\text{N.G.S.} = n\left(a + b + c + \ldots + \frac{m}{2}\right) + \frac{m}{2}$$

where N.G.S. denotes normal growing stock; "n" — the age interval for which yield and increment are shown in the yield tables; "a", "b", "c", etc. represent volume per acre shown in the yield tables for a range of age from the lowest shown in the yield tables (volume "a") up to rotation age (volume "m").

The volume of N.G.S. resulting from the formula is the volume occurring on an area equal in acres to the number of years in the rotation. If, for example, the adopted rotation is 120 years, then the normal growing stock volume derived by the formula is the volume on 120 acres. Separate calculations must be carried out for each site class in the working group.

Normal Increment. In forest management, the annual current increment of a working group may be regarded as being produced by stands covering the full age range in a specific rotation; each stand would have normal stocking and be on an area of normal size. Increment so defined is equal to the volume of a normal mature stand, which is merely the accumulated normal increment on a unit area over the whole rotation. For most practical purposes this volume is used for computing the normal annual current increment for a working group. Calculations are carried out by site classes.

Calculation of the normal growing stock and increment for a working group is illustrated by the following example.

Within a management unit all black spruce stands, either pure or with black spruce predominant, were assembled into a black spruce working group with an accepted rotation of 120 years. The productive forest area of the working group is 285,000 acres, broken down by site classes as follows:

Site-class 1 —	20,500 acres
" 2 —	160,000 "
" 3 —	104,500 "
TOTAL	285,000 acres

(1) The normal growing stock of the working group was calculated for each site class separately, then totaled.

Using the formula shown above for N.G.S., the calculation of the normal growing stock for site-class 1 (rotation 120 years, n = 5, mature volume "m" equal 4,658 cubic feet) is as follows:

$$\text{N.G.S.} = 5\left(265 + 586 + 916 + 1245 + 1567 + 1880 + 2179 + 2463 + 2729 + 2978 + 3209 + 3424 + 3621 + 3803 + 3971 + 4126 + 4263 + 4384 + 4489 + 4581 + \frac{4658}{2}\right) + \frac{4658}{2} = 5 \times (59{,}008) + 2329 = 297{,}369 \text{ cu. ft.}$$

Because the volume of 297,369 is on 120 acres (120-year rotation was adopted), the normal growing stock for the total area of site-class 1 (20,500 acres) would be:

$$\frac{297{,}369 \times 20{,}500}{120} = 50{,}800{,}540 \text{ cubic feet}$$

In the same manner, the normal growing stock for site-classes 2 and 3 were computed, and the normal growing stock for the whole black spruce working group is:

Site-class 1 —	50,800,540 cu. ft.
" 2 —	301,102,665 " "
" 3 —	118,469,910 " "
TOTAL N.G.S. =	470,373,115 cu. ft.

(2) The normal annual current increment for the same working group was determined for each site class as follows:

Site-class 1 — Normal volume at rotation age (120 years) is 4,658 cu. ft. per acre. This is equal to the normal annual increment of a normal forest 120 acres in area. Thus, for the whole area of site-class 1, the normal increment is:

$$\frac{20{,}500 \times 4658}{120} = 795{,}742 \text{ cu. ft.}$$

The same calculations are carried out for site-classes 2 and 3, and the normal current increment for the whole working group is:

Site-class 1 —	795,742 cu. ft.
" 2 —	5,032,000 " "
" 3 —	2,319,900 " "
TOTAL C.A.I.	8,147,642 cu. ft.

For a whole management unit or working circle, calculations of N.G.S. and C.A.I. are carried out for each working group by itself.

USE OF THE TABLES IN AERIAL PHOTOGRAPHIC METHOD OF SURVEY

Since considerable progress has been made in the aerial photography technique, and still further development is under way, there is well-founded hope that normal yield tables will be satisfactorily employed in an inventory based upon aerial photographs.

As for an inventory conducted on the ground, the same three stand features are required when making an inventory from aerial photographs, namely, stand age, height and stocking.

For the most part, age cannot be accurately determined from photographs alone. Therefore it is essential to obtain reliable information from other sources, such as past cruising records, fires, woods operations, and inspections on the ground. These data can then be tied in with aerial photographs and used to determine the age of each stand.

Height can be determined from photographs accurately enough for all practical purposes. Because there are only three site classes in the present yield tables, and each extends over a relatively wide height range, it is easy to determine site class from age and height, as interpreted from photographs.

The most involved task is to determine the stocking factor for a stand. At present, no suitable stand characteristic other than crown density is available, and until another approach secures better results, the stocking factor should be determined, indirectly, from density. With an adequate number of field observations on the stocking of stands under various conditions of growth, and with the density data determined from photographs of the same stands, the relation of stocking to density, by age and site class, can be established. The results should be arranged in a convenient tabular form for each species, and appended to the yield tables for use in successive inventories of a working circle.

With age, stand height and stocking determined in this manner, normal yield tables may be used directly to estimate the actual volume and annual increment for each typed stand, and the normal growing stock and increment for a working group.

Growth is slow on poor sites, as illustrated by this 81-year-old black spruce stand where the average height is only 28.4 feet. The site-class is therefore 3.1. Although the basal area is 135.6 sq. ft., a slightly overstocked condition, and the total volume per acre is 1,992 cubic feet, the gross merchantable volume is only 377 cu. ft., or 4.4 cords per acre. However, with the merchantable volume growing at an annual rate of 9.89 per cent, there is hope that this stand may some day be operable.

CALCULATION AND DISTRIBUTION OF THE ALLOWABLE CUT

To calculate the annual allowable cut for a forest under a clear-cutting system, both area and volume methods are usually used at the same time. These calculations are carried out for each working group, separately.

There are several area methods for determining the allowable cut, but the best basis is a summary of stands by age classes. Such a summary shows the area of barren forest land, which is suitable for forest production but does not grow forest crop at the moment, the area with scattered trees (stocked 0.2 and less), and the area of forest growth in twenty-year age-class groups, such as 1-20, 21-40, etc. From the total forest area and rotation, the normal area allotment may be found for each age class, which, compared with the actual size of age classes in a working group, indicates where there is a surplus or deficiency of area. A decision is then made on how to utilize surpluses and restrict utilization to meet deficiencies, and on the length of the adjustment period. The adjustment period should be such that the desired even flow of wood supply can be achieved without too great sacrifices on the growing stock. From such considerations the allowable cut by area is finally determined.

Next, the allowable cut is calculated by volume, and several methods are available, depending on the type of data supplied by inventory. For an inventory conducted by stands, in which site class, volume and annual current increment are computed from the normal yield tables, the formula by Gehrhardt can be used with advantage to calculate the annual allowable cut by volume:

$$\text{Annual allowable cut} = \frac{\text{Actual C.A.I.} + \text{Normal C.A.I.}}{2} + \frac{\text{Actual G. S.} - \text{Normal G. S.}}{\text{Adjustment Period}}$$

The actual annual current increment, and growing stock, are taken from inventory, because both these figures are shown in the summary of a working group.

The normal increment and growing stock, on the other hand, are computed from the normal yield tables in the manner described on previous pages.

Calculation of the allowable cut, by area and volume, results from a planned improvement of age-class distribution and application of a volumetric formula. According to these calculations, the stands to be cut within the next ten-year period should be so chosen that their area and volume are in agreement with the allowable cut. In selecting stands, full consideration must be given to improvement of the growing stock. This can be achieved only if poorly stocked stands, as well as those with no appreciable increment or undesirable in other ways, are first dedicated to be used, along with well-stocked mature stands, thus making a balanced allowable cut. This is perhaps the most important task in regulating yield, which indeed cannot be done without a detailed inventory where stocking, volume and increment are shown for each stand. This type of inventory can be accomplished only with the aid of normal yield tables, which are the standard for assessing the abnormality of individual stands.

BLACK SPRUCE

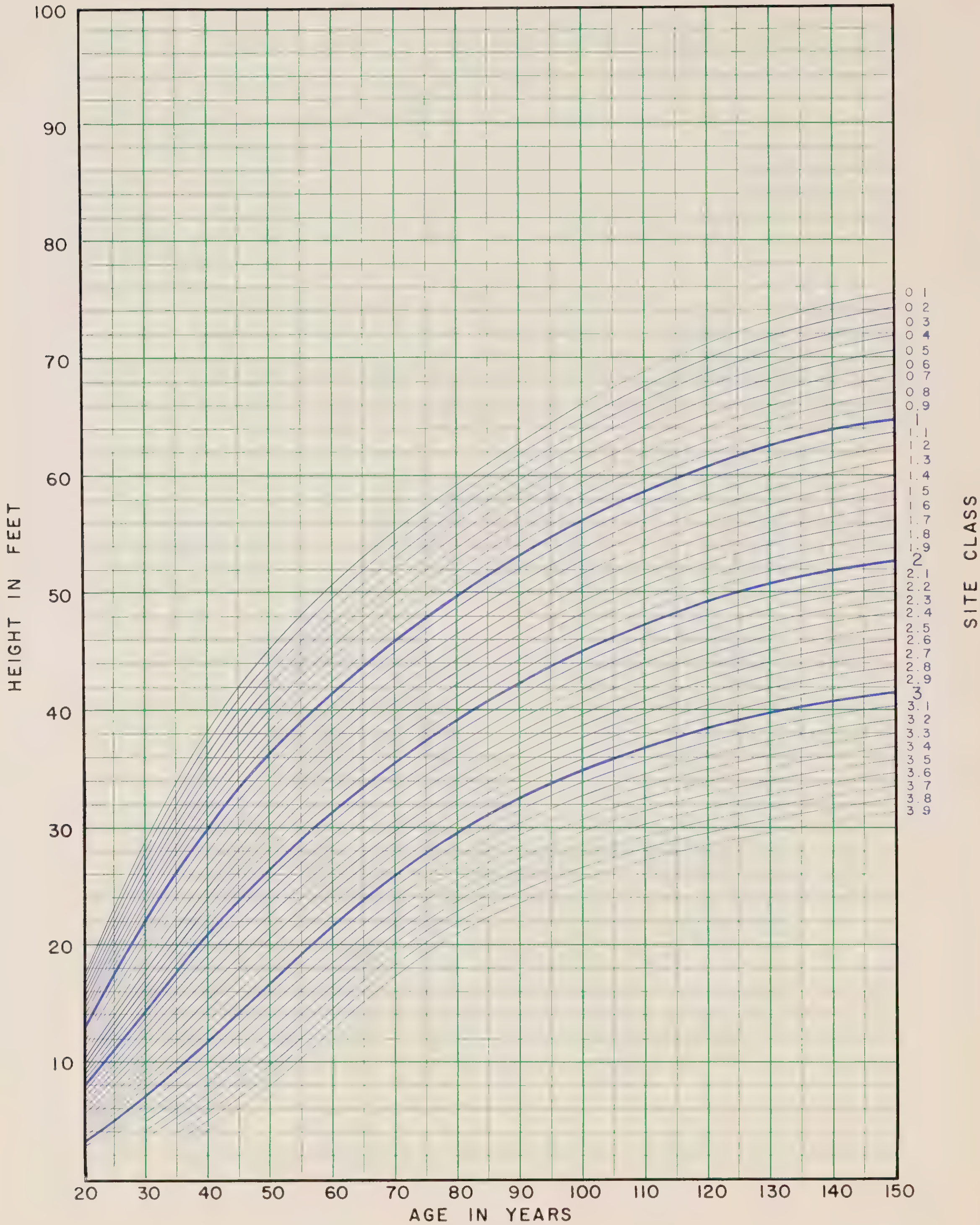
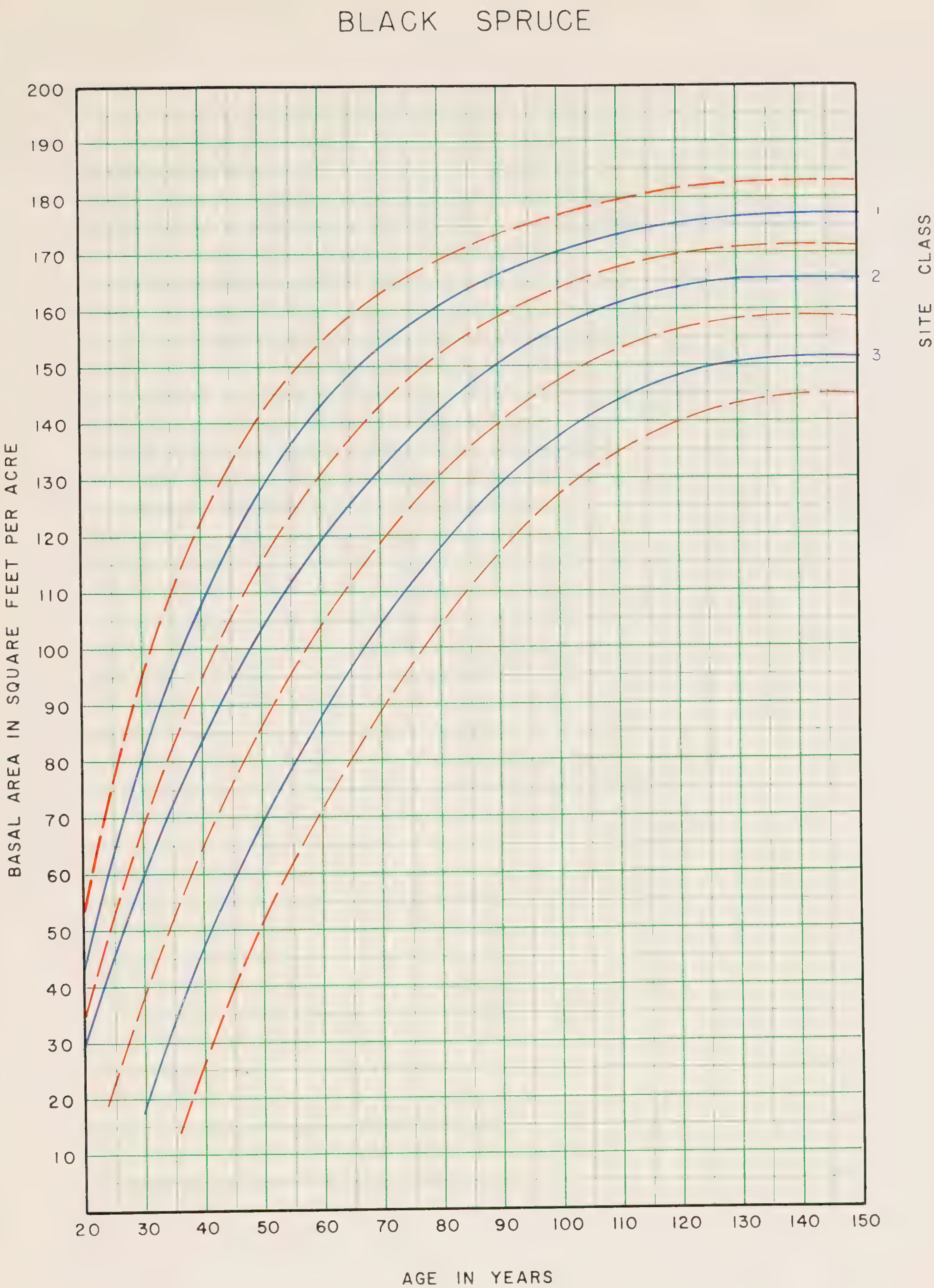


FIGURE 5



BLACK SPRUCE
BASAL AREA IN SQUARE FEET PER ACRE
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
AGE IN YEARS
1
2
3
SITE CLASS

FIGURE 6

BLACK SPRUCE

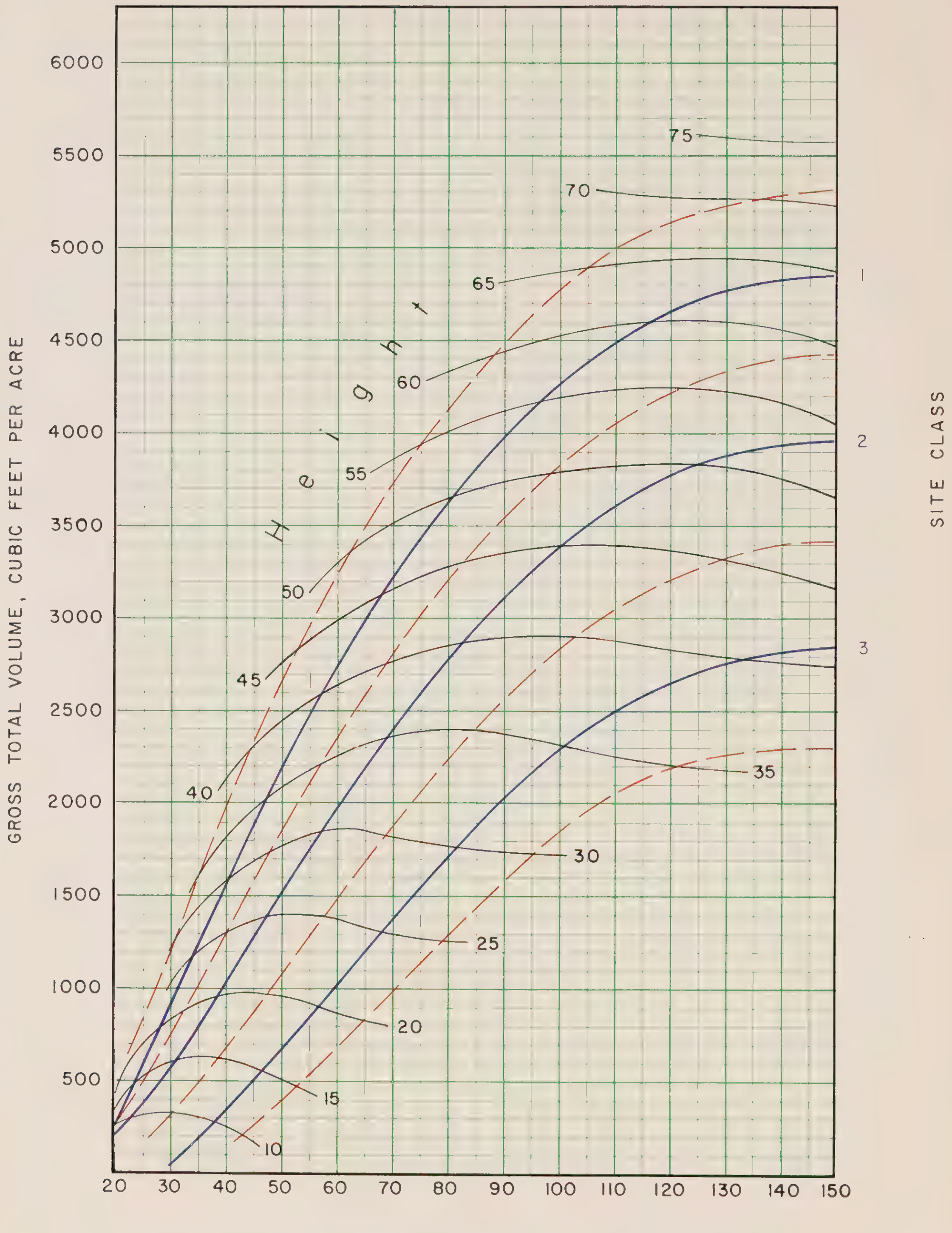


FIGURE 7

Table 3

BLACK SPRUCE

SITE-CLASS 1

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre						Gross Merch. Vol., Cu. Ft. per Acre			Age in Years
					Main Stand			Suppressed Trees		Total Production	Main Stand			
					Volume	C.A.I.	M.A.I.	Volume	Cumulative		Volume	C.A.I.	M.A.I.	
20	12.5	1.4	3745	42.0	265		13.2			265				20
						64.2								
25	17.4	1.9	3200	62.8	586		23.4	11	11	597				25
						66.0								
30	22.1	2.3	2720	80.0	916		30.5	26	37	953				30
						65.8								
35	26.1	2.8	2275	95.1	1245		35.6	42	79	1324	330		9.4	35
						64.4						49.0		
40	29.9	3.2	1911	107.6	1567		39.2	46	125	1692	575		14.4	40
						62.6						50.2		
45	33.3	3.6	1676	118.4	1880		41.8	49	174	2054	826		18.4	45
						59.8						50.8		
50	36.1	3.9	1505	128.0	2179		43.6	51	225	2404	1080		21.6	50
						56.8						51.0		
55	39.0	4.3	1369	136.2	2463		44.8	54	279	2742	1335		24.3	55
						53.2						51.0		
60	41.3	4.6	1265	143.1	2729		45.5	58	337	3066	1590		26.5	60
						49.8						50.4		
65	43.8	4.8	1178	148.6	2978		45.8	59	396	3374	1842		28.3	65
						46.2						49.6		
70	45.8	5.0	1105	153.3	3209		45.8	60	456	3665	2090		29.9	70
						43.0						48.8		
75	47.9	5.3	1037	157.3	3424		45.7	61	517	3941	2334		31.1	75
						39.4						47.4		
80	49.7	5.5	977	160.8	3621		45.3	64	581	4202	2571		32.1	80
						36.4						46.0		
85	51.5	5.7	922	163.8	3803		44.7	65	646	4449	2801		33.0	85
						33.6						44.0		
90	53.1	5.9	874	166.4	3971		44.1	65	711	4682	3021		33.6	90
						31.0						42.0		
95	54.7	6.1	832	168.7	4126		43.4	64	775	4901	3231		34.0	95
						27.4						39.2		
100	56.0	6.3	794	170.6	4263		42.6	62	837	5100	3427		34.3	100
						24.2						36.2		
105	57.4	6.5	758	172.2	4384		41.8	61	898	5282	3608		34.4	105
						21.0						32.6		
110	58.5	6.6	727	173.6	4489		40.8	60	958	5447	3771		34.3	110
						18.4						27.8		
115	59.7	6.8	699	174.7	4581		39.8	59	1017	5598	3910		34.0	115
						15.4						22.2		
120	60.6	6.9	672	175.6	4658		38.8	53	1070	5728	4021		33.5	120
						12.6						16.6		
125	61.5	7.1	649	176.3	4721		37.8	50	1120	5841	4104		32.8	125
						9.6						11.0		
130	62.3	7.2	630	176.8	4769		36.7	48	1168	5937	4159		32.0	130
						7.0						7.0		
135	63.0	7.3	611	177.1	4804		35.6	45	1213	6017	4194		31.1	135
						5.0						4.2		
140	63.6	7.4	596	177.3	4829		34.5	41	1254	6083	4215		30.1	140
						3.6						2.0		
145	64.1	7.5	580	177.4	4847		33.4	35	1289	6136	4225		29.1	145
						2.4						1.0		
150	64.6	7.6	565	177.3	4859		32.4	32	1321	6180	4230		28.2	150

Table 4

BLACK SPRUCE

SITE-CLASS 2

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	7.8	1.0	4667	28.0	217		10.8			217				20
						32.4								
25	11.1	1.4	4062	43.7	379		15.2	25	25	404				25
						39.0								
30	14.6	1.8	3476	58.2	574		19.1	25	50	624				30
						43.0								
35	17.9	2.1	2975	71.1	789		22.5	32	82	871				35
						46.2								
40	20.9	2.4	2601	82.7	1020		25.5	27	109	1129				40
						49.0								
45	23.7	2.7	2264	93.2	1265		28.1	29	138	1403				45
						48.2								
50	26.4	3.0	2036	102.6	1506		30.1	30	168	1674				50
						47.0								
55	29.0	3.3	1861	111.0	1741		31.7	31	199	1940				55
						45.6								
60	31.2	3.5	1727	118.5	1969		32.8	32	231	2200	295		4.9	60
						43.6						43.0		
65	33.4	3.8	1617	125.4	2187		33.6	33	264	2451	510		7.8	65
						41.6						49.0		
70	35.4	4.0	1524	131.5	2395		34.2	34	298	2693	755		10.8	70
						39.2						50.6		
75	37.3	4.2	1448	137.3	2591		34.5	36	334	2925	1008		13.4	75
						36.0						49.0		
80	39.1	4.4	1378	142.3	2771		34.6	37	371	3142	1253		15.7	80
						35.2						46.4		
85	40.7	4.5	1317	146.8	2947		34.7	38	409	3356	1485		17.5	85
						31.8						43.0		
90	42.3	4.7	1254	150.8	3106		34.5	38	447	3553	1700		18.9	90
						29.2						40.0		
95	43.8	4.8	1207	154.4	3252		34.2	39	486	3738	1900		20.0	95
						26.4						37.0		
100	45.0	5.0	1160	157.3	3384		33.8	38	524	3908	2085		20.8	100
						23.8						34.2		
105	46.2	5.1	1114	159.6	3503		33.4	37	561	4064	2256		21.5	105
						20.8						31.0		
110	47.3	5.3	1072	161.5	3607		32.8	36	597	4204	2411		21.9	110
						18.2						28.4		
115	48.3	5.4	1032	163.1	3698		32.2	35	632	4330	2553		22.2	115
						15.2						25.2		
120	49.2	5.5	993	164.3	3774		31.4	34	666	4440	2679		22.3	120
						12.4						21.8		
125	50.0	5.6	958	165.0	3836		30.7	33	699	4535	2788		22.3	125
						9.2						18.0		
130	50.7	5.7	925	165.4	3882		29.9	33	732	4614	2878		22.1	130
						6.8						15.0		
135	51.3	5.8	898	165.4	3916		29.0	32	764	4680	2953		21.9	135
						5.0						12.2		
140	51.9	5.9	875	165.4	3941		28.2	29	793	4734	3014		21.5	140
						3.4						9.8		
145	52.3	6.0	855	165.4	3958		27.3	25	818	4776	3063		21.2	145
						2.2						7.4		
150	52.7	6.0	839	165.4	3969		26.5	23	841	4810	3100		20.7	150

Table 5

BLACK SPRUCE

SITE-CLASS 3

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	3.1													20
25	5.0													25
30	7.1	0.9	4288	17.0	153		5.1	3	3	156				30
						17.4								
35	9.4	1.3	3635	32.6	240		6.9	12	15	255				35
						23.0								
40	11.8	1.6	3145	46.0	355		8.9	12	27	382				40
						29.4								
45	14.2	1.9	2818	57.8	502		11.2	13	40	542				45
						33.4								
50	16.7	2.2	2560	68.4	669		13.4	13	53	722				50
						35.2								
55	19.3	2.5	2353	78.3	845		15.4	14	67	912				55
						36.4								
60	21.6	2.7	2190	87.4	1027		17.1	14	81	1108				60
						36.8								
65	23.9	2.9	2061	95.7	1211		18.6	15	96	1307				65
						36.0								
70	25.9	3.1	1950	103.7	1391		19.9	15	111	1502				70
						35.0								
75	27.8	3.3	1859	110.9	1566		20.9	16	127	1693				75
						33.4								
80	29.6	3.5	1776	117.6	1733		21.7	18	145	1878	366		4.6	80
						31.4						38.0		
85	31.2	3.7	1698	123.6	1890		22.2	19	164	2054	556		6.5	85
						29.6						38.0		
90	32.5	3.8	1630	128.8	2038		22.6	20	184	2222	746		8.3	90
						27.4						35.2		
95	33.8	4.0	1566	133.5	2175		22.9	22	206	2381	922		9.7	95
						25.0						32.6		
100	34.9	4.1	1507	137.6	2300		23.0	23	229	2529	1085		10.8	100
						22.2						30.0		
105	35.9	4.2	1453	141.2	2411		23.0	24	253	2664	1235		11.8	105
						19.8						27.2		
110	36.8	4.3	1404	144.2	2510		22.8	27	280	2790	1371		12.5	110
						16.8						24.4		
115	37.7	4.4	1358	146.6	2594		22.6	26	306	2900	1493		13.0	115
						14.0						21.8		
120	38.4	4.5	1315	148.4	2664		22.2	25	331	2995	1602		13.4	120
						11.2						19.0		
125	39.1	4.6	1275	149.7	2720		21.8	23	354	3074	1697		13.6	125
						9.0						16.6		
130	39.7	4.7	1240	150.4	2765		21.3	22	376	3141	1780		13.7	130
						6.6						14.0		
135	40.2	4.8	1207	151.1	2798		20.7	18	394	3192	1850		13.7	135
						4.4						11.8		
140	40.7	4.9	1178	151.6	2820		20.1	18	412	3232	1909		13.6	140
						3.2						9.8		
145	41.0	4.9	1152	151.7	2836		19.6	15	427	3263	1958		13.5	145
						2.4						7.8		
150	41.4	5.0	1129	151.8	2848		19.0	13	440	3288	1997		13.3	150

JACK PINE

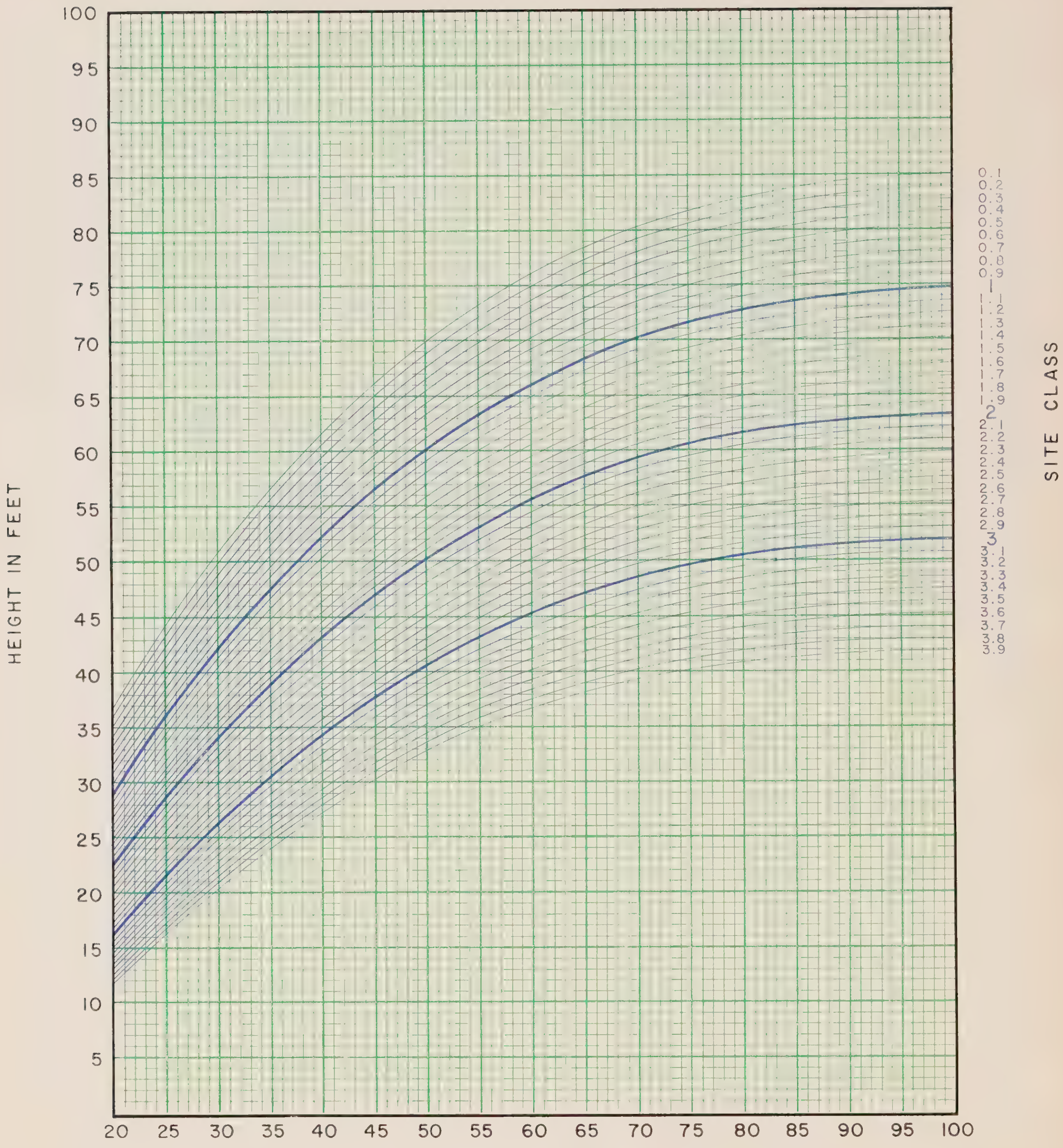


FIGURE 8

JACK PINE

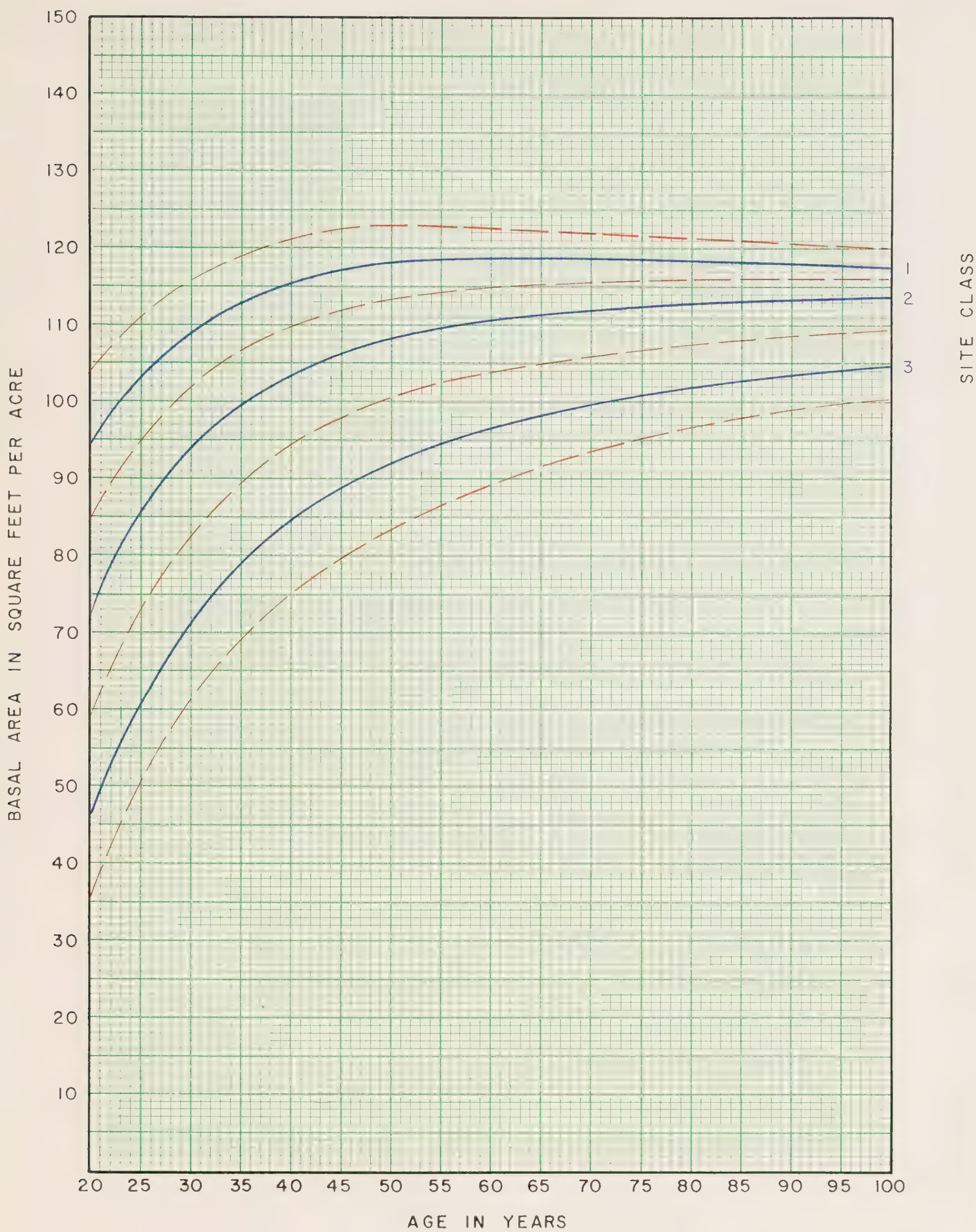


Figure 9

JACK PINE

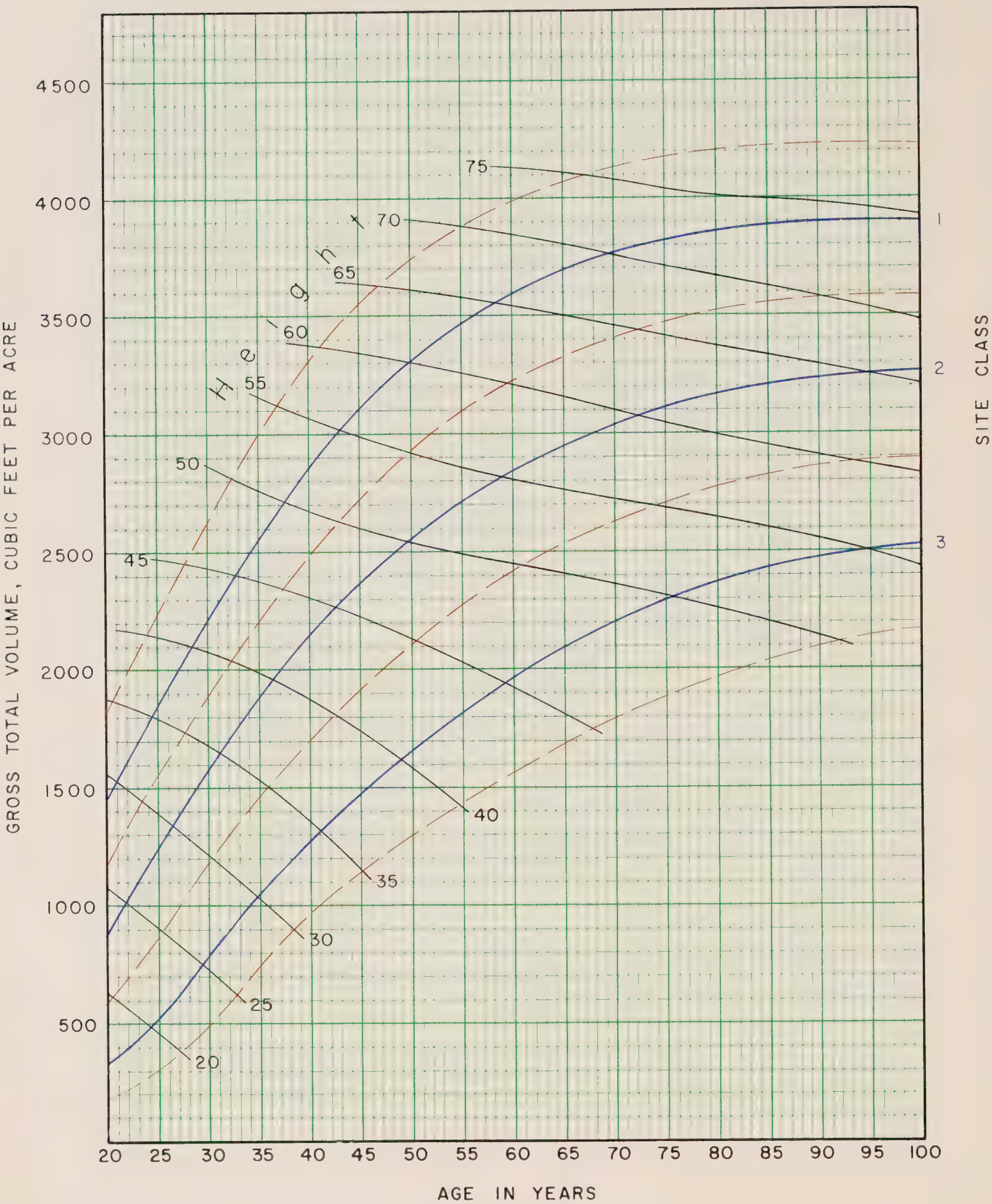


FIGURE 10

Table 6

JACK PINE

SITE-CLASS 1

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	28.7	2.6	2558	94.4	1465		73.2	38	38	1503	248		12.4	20
						79.0						87.2		
25	35.8	3.6	1479	103.2	1860		74.4	85	123	1983	684		27.4	25
						73.0						117.6		
30	42.0	4.3	1084	109.0	2225		74.2	124	247	2472	1272		42.4	30
						67.6						102.4		
35	47.5	5.0	832	112.9	2563		73.2	146	393	2956	1784		51.0	35
						60.4						85.8		
40	52.3	5.6	682	115.5	2865		71.6	160	553	3418	2213		55.3	40
						50.8						67.2		
45	56.5	6.1	581	117.1	3119		69.3	170	723	3842	2549		56.6	45
						40.4						52.0		
50	60.1	6.6	504	118.0	3321		66.4	175	898	4219	2809		56.2	50
						31.6						41.8		
55	63.3	7.0	445	118.5	3479		63.3	173	1071	4550	3018		54.9	55
						25.2						33.4		
60	66.0	7.4	399	118.7	3605		60.1	163	1234	4839	3185		53.1	60
						19.4						25.6		
65	68.3	7.7	363	118.7	3702		57.0	150	1384	5086	3313		51.0	65
						15.2						19.2		
70	70.2	8.1	334	118.7	3778		54.0	131	1515	5293	3409		48.7	70
						11.2						13.6		
75	71.7	8.4	311	118.6	3834		51.1	114	1629	5463	3477		46.4	75
						7.6						9.2		
80	72.8	8.6	294	118.5	3872		48.4	96	1725	5597	3523		44.0	80
						4.4						5.8		
85	73.6	8.8	282	118.3	3894		45.8	79	1804	5698	3552		41.8	85
						2.4						3.4		
90	74.2	8.9	272	118.1	3906		43.4	59	1863	5769	3569		39.7	90
						1.2						2.0		
95	74.6	9.0	265	117.9	3912		41.2	37	1900	5812	3579		37.7	95
						.4						1.6		
100	74.9	9.1	260	117.7	3914		39.1	17	1917	5831	3587		35.9	100

Table 7

JACK PINE

SITE-CLASS 2

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre						Gross Merch. Vol., Cu. Ft. per Acre			Age in Years
					Main Stand			Suppressed Trees		Total Production	Main Stand			
					Volume	C.A.I.	M.A.I.	Volume	Cumulative		Volume	C.A.I.	M.A.I.	
20	22.3	1.8	4118	72.7	894		44.7	31	31	925	32		1.6	20
						71.8						58.2		
25	28.4	2.7	2201	85.8	1253		50.1	69	100	1353	323		12.9	25
						67.2						64.6		
30	33.9	3.3	1541	93.9	1589		53.0	102	202	1791	646		21.5	30
						60.4						64.4		
35	38.8	4.0	1141	99.5	1891		54.0	138	340	2231	968		27.7	35
						54.2						62.6		
40	43.1	4.5	921	103.4	2162		54.0	148	488	2650	1281		32.0	40
						44.6						59.6		
45	46.9	5.0	771	106.2	2385		53.0	162	650	3035	1579		35.1	45
						36.4						55.2		
50	50.3	5.5	664	108.1	2567		51.3	161	811	3378	1855		37.1	50
						30.8						49.4		
55	53.2	5.9	584	109.5	2721		49.5	142	953	3674	2102		38.2	55
						26.0						42.0		
60	55.7	6.2	524	110.5	2851		47.5	122	1075	3926	2312		38.5	60
						21.8						34.4		
65	57.8	6.5	477	111.3	2960		45.5	102	1177	4137	2484		38.2	65
						18.0						27.4		
70	59.4	6.8	440	111.9	3050		43.6	85	1262	4312	2621		37.4	70
						14.6						20.4		
75	60.7	7.1	412	112.4	3123		41.6	71	1333	4456	2723		36.3	75
						11.0						14.6		
80	61.7	7.3	391	112.8	3178		39.7	60	1393	4571	2796		35.0	80
						8.0						10.0		
85	62.4	7.4	376	113.1	3218		37.9	49	1442	4660	2846		33.5	85
						5.6						6.4		
90	62.9	7.6	364	113.3	3246		36.1	37	1479	4725	2878		32.0	90
						3.6						3.8		
95	63.2	7.7	355	113.5	3264		34.4	27	1506	4770	2897		30.5	95
						2.4						2.4		
100	63.5	7.7	347	113.6	3276		32.8	18	1524	4800	2909		29.1	100

Table 8

JACK PINE

SITE-CLASS 3

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	Main Stand: C.A.I.	Main Stand: M.A.I.	Suppressed Trees: Volume	Suppressed Trees: Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	Main Stand: C.A.I.	Main Stand: M.A.I.	Age in Years
20	16.0			46.5	348		17.4	10	10	358				20
						37.8								
25	21.3	1.9	3181	60.9	537		21.5	46	56	593				25
						54.2								
30	26.0	2.4	2243	71.3	808		26.9	75	131	939	165		5.5	30
						50.2						42.6		
35	30.3	3.0	1625	78.9	1059		30.3	92	223	1282	378		10.8	35
						45.4						45.8		
40	34.2	3.5	1242	84.5	1286		32.2	101	324	1610	607		15.2	40
						40.0						46.8		
45	37.6	4.0	1003	88.7	1486		33.0	106	430	1916	841		18.7	45
						35.8						45.8		
50	40.6	4.4	863	91.9	1665		33.3	99	529	2194	1070		21.4	50
						32.6						43.0		
55	43.2	4.8	759	94.4	1828		33.2	87	616	2444	1285		23.4	55
						29.6						39.6		
60	45.4	5.1	679	96.5	1976		32.9	74	690	2666	1483		24.7	60
						26.0						35.6		
65	47.2	5.4	619	98.2	2106		32.4	65	755	2861	1661		25.6	65
						21.8						30.0		
70	48.7	5.6	575	99.7	2215		31.6	59	814	3029	1811		25.9	70
						18.0						23.0		
75	49.8	5.8	543	100.9	2305		30.7	52	866	3171	1926		25.7	75
						14.8						17.0		
80	50.6	6.0	520	101.9	2379		29.7	44	910	3289	2011		25.1	80
						11.8						12.2		
85	51.2	6.1	504	102.8	2438		28.7	35	945	3383	2072		24.4	85
						9.0						8.4		
90	51.6	6.2	491	103.5	2483		27.6	29	974	3457	2114		23.5	90
						6.4						5.4		
95	51.8	6.3	479	104.1	2515		26.5	24	998	3513	2141		22.5	95
						4.0						3.0		
100	52.0	6.4	468	104.6	2535		25.4	19	1017	3552	2156		21.6	100

ASPEN

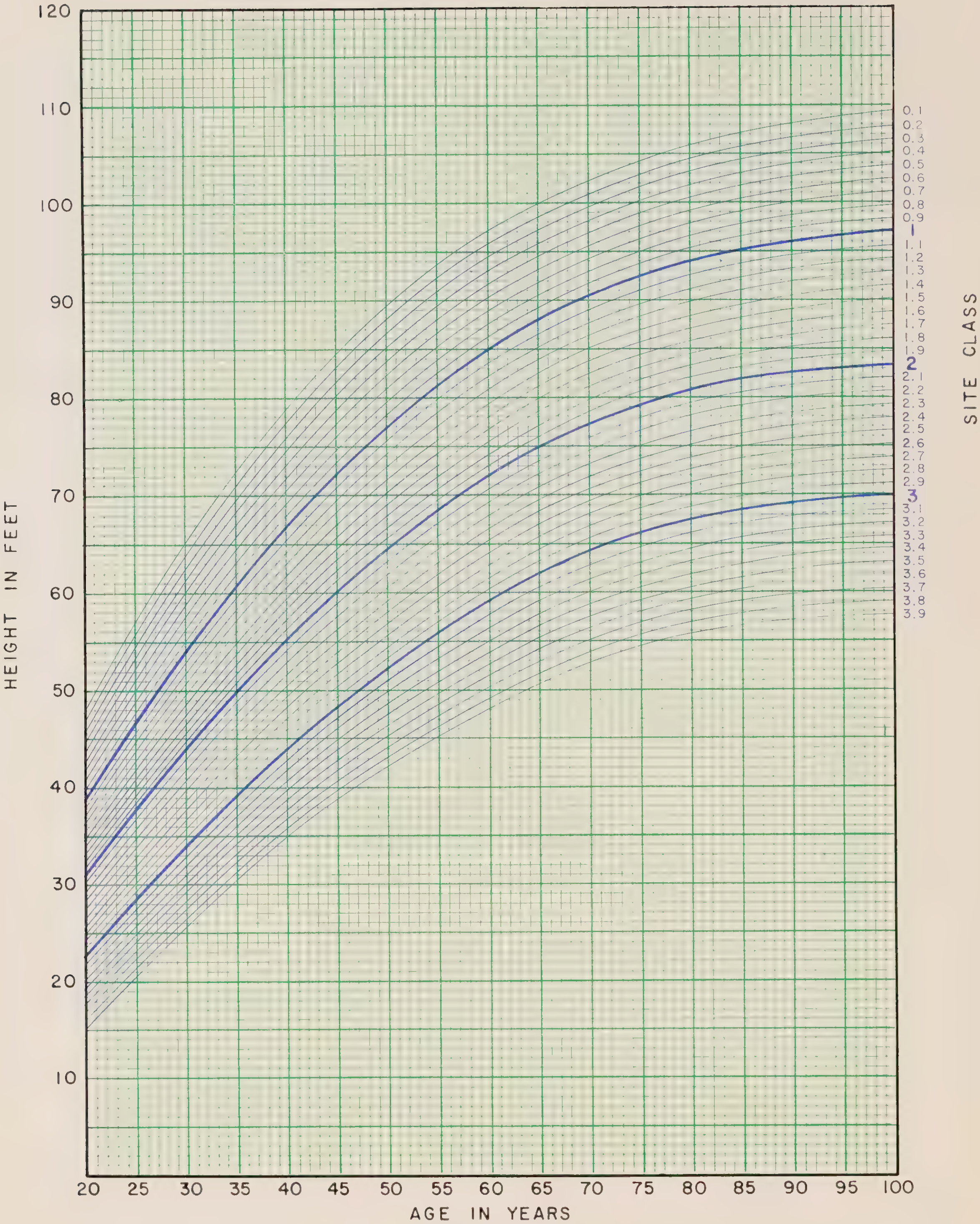


FIGURE 11

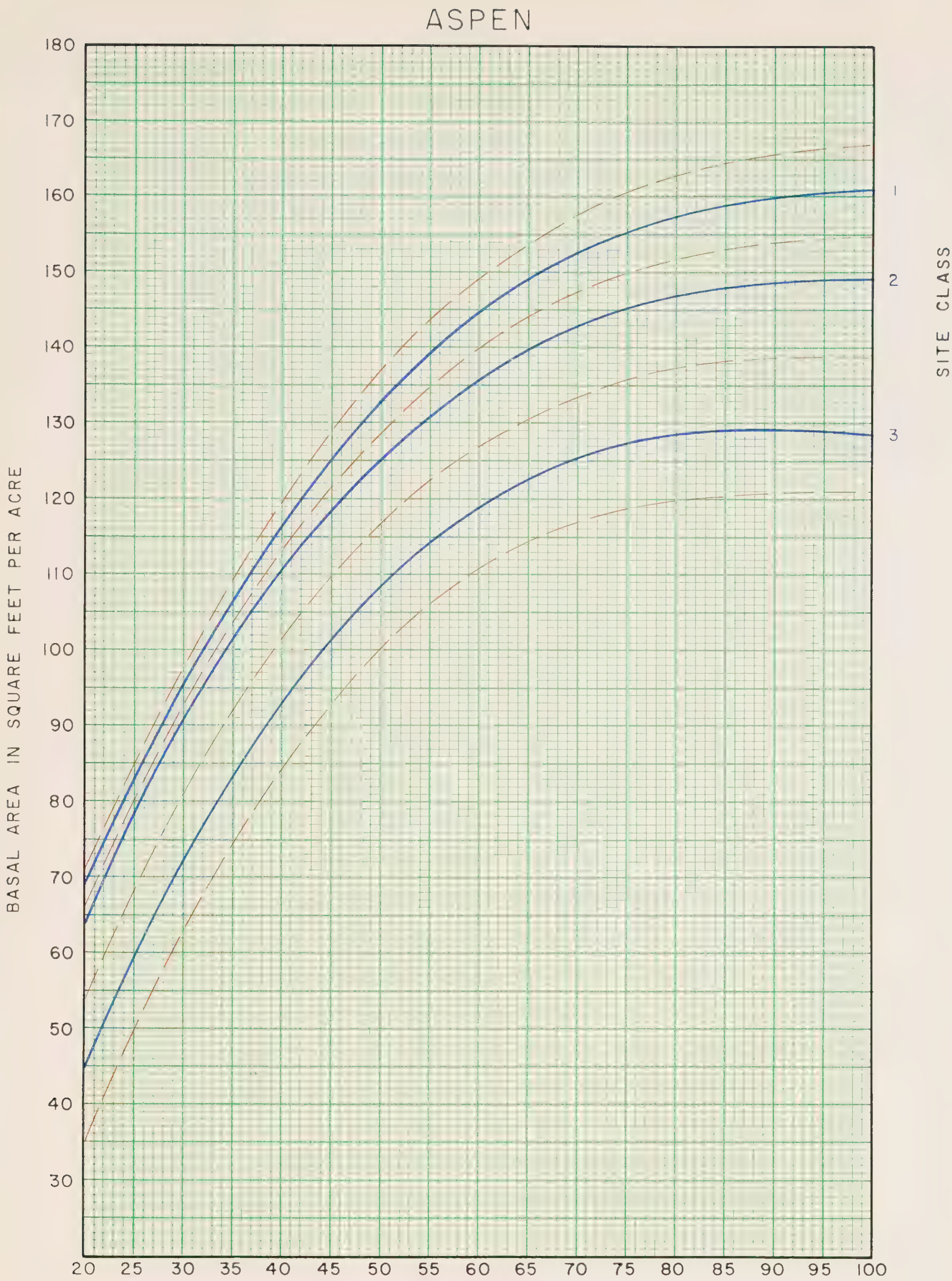

ASPEN
BASAL AREA IN SQUARE FEET PER ACRE
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
AGE IN YEARS
1
2
3
SITE CLASS

FIGURE 12

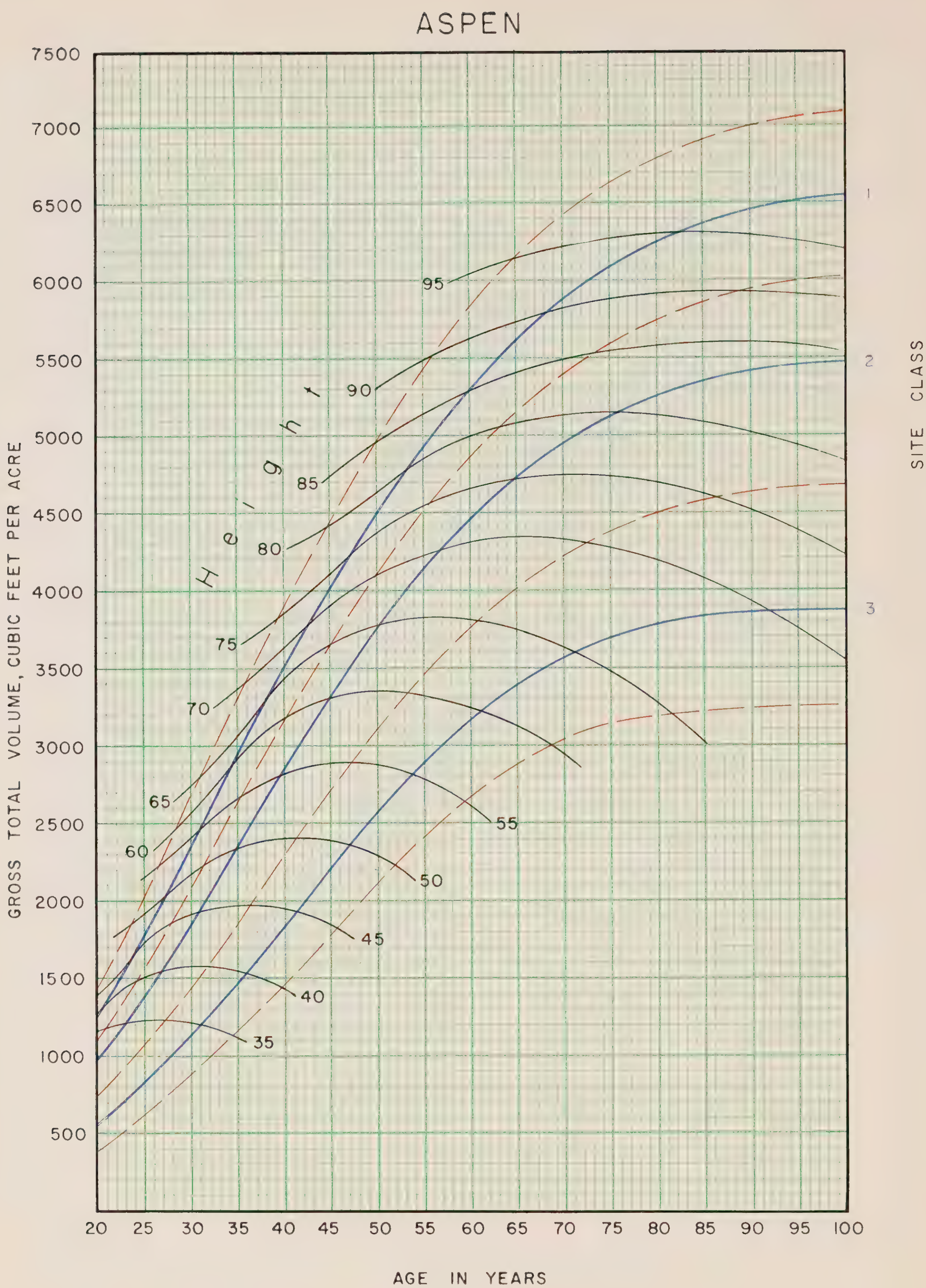

ASPEN
GROSS TOTAL VOLUME, CUBIC FEET PER ACRE
AGE IN YEARS
SITE CLASS
Height
1
2
3
35
40
45
50
55
60
65
70
75
80
85
90
95
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100

FIGURE 13

Table 9

ASPEN

SITE-CLASS 1

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	38.7	3.5	1022	68.5	1245		62.2	63	63	1308	420		21.0	20
						105.0						109.6		
25	46.6	4.2	840	82.4	1770		70.8	90	153	1923	968		38.7	25
						116.2						127.2		
30	53.8	5.0	698	95.0	2351		78.4	116	269	2620	1604		53.5	30
						117.0						136.8		
35	60.6	5.7	590	106.2	2936		83.9	142	411	3347	2288		65.4	35
						112.0						123.0		
40	66.7	6.5	508	116.2	3496		87.4	160	571	4067	2903		72.6	40
						104.6						108.6		
45	72.2	7.2	442	125.0	4019		89.3	176	747	4766	3446		76.6	45
						95.8						97.2		
50	77.1	7.9	389	132.6	4498		90.0	168	915	5413	3932		78.6	50
						86.0						83.0		
55	81.3	8.6	344	139.1	4928		89.6	160	1075	6003	4347		79.0	55
						75.0						69.4		
60	85.0	9.3	307	144.5	5303		88.4	152	1227	6530	4694		78.2	60
						63.0						57.6		
65	88.1	9.9	278	148.9	5618		86.4	144	1371	6989	4982		76.6	65
						52.0						46.2		
70	90.7	10.5	253	152.4	5878		84.0	126	1497	7375	5213		74.5	70
						42.0						35.8		
75	92.8	11.0	233	155.2	6088		81.2	110	1607	7695	5392		71.9	75
						33.2						26.4		
80	94.4	11.5	217	157.3	6254		78.2	92	1699	7953	5524		69.0	80
						24.8						18.8		
85	95.6	11.9	204	158.8	6378		75.0	76	1775	8153	5618		66.1	85
						17.2						13.2		
90	96.4	12.3	193	159.8	6464		71.8	62	1837	8301	5684		63.2	90
						11.4						8.8		
95	97.0	12.6	185	160.5	6521		68.6	48	1885	8406	5728		60.3	95
						8.2						5.8		
100	97.5	12.8	179	161.0	6562		65.6	32	1917	8479	5757		57.6	100

Table 10

ASPEN

SITE-CLASS 2

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	30.8	3.1	1236	62.9	969		48.4	28	28	997	159		8.0	20
						82.0						63.4		
25	37.6	3.7	1031	77.7	1379		55.2	46	74	1453	476		19.0	25
						92.8						93.2		
30	43.9	4.3	884	90.3	1843		61.4	66	140	1983	942		31.4	30
						100.0						118.0		
35	49.8	4.9	765	101.0	2343		66.9	85	225	2568	1532		43.8	35
						99.6						123.6		
40	55.2	5.5	667	110.2	2841		71.0	109	334	3175	2150		53.8	40
						95.0						113.2		
45	60.1	6.1	587	118.1	3316		73.7	124	458	3774	2716		60.4	45
						89.0						97.4		
50	64.6	6.6	520	124.9	3761		75.2	136	594	4355	3203		64.1	50
						76.6						83.0		
55	68.6	7.2	462	130.7	4144		75.3	144	738	4882	3618		65.8	55
						64.2						68.8		
60	72.1	7.8	412	135.5	4465		74.4	147	885	5350	3962		66.0	60
						53.4						56.0		
65	75.1	8.3	370	139.5	4732		72.8	141	1026	5758	4242		65.3	65
						44.0						44.4		
70	77.6	8.8	334	142.7	4952		70.7	125	1151	6103	4464		63.8	70
						35.0						34.2		
75	79.6	9.3	305	145.1	5127		68.4	111	1262	6389	4635		61.8	75
						27.0						25.2		
80	81.1	9.8	280	146.7	5262		65.8	96	1358	6620	4761		59.5	80
						19.4						17.0		
85	82.2	10.2	261	147.8	5359		63.0	82	1440	6799	4846		57.0	85
						12.6						10.0		
90	82.9	10.5	246	148.4	5422		60.2	68	1508	6930	4896		54.4	90
						7.8						4.2		
95	83.4	10.8	234	148.7	5461		57.5	54	1562	7023	4917		51.8	95
						4.8						—0.4		
100	83.8	11.0	225	148.8	5485		54.8	40	1602	7087	4915		49.2	100

Table 11

ASPEN

SITE-CLASS 3

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	22.6	2.2	1667	44.2	558		27.9	4	4	562				20
						54.0								
25	28.3	2.8	1403	58.7	828		33.1	14	18	846	47		1.9	25
						61.8						35.2		
30	33.9	3.3	1200	71.6	1137		37.9	27	45	1182	223		7.4	30
						68.0						53.6		
35	39.2	3.8	1039	82.9	1477		42.2	41	86	1563	491		14.0	35
						72.6						68.6		
40	44.0	4.3	905	92.7	1840		46.0	52	138	1978	834		20.8	40
						74.4						80.8		
45	48.2	4.8	793	101.0	2212		49.2	62	200	2412	1238		27.5	45
						72.0						91.0		
50	52.3	5.3	698	108.0	2572		51.4	70	270	2842	1693		33.9	50
						64.6						96.6		
55	56.0	5.8	618	113.9	2895		52.6	77	347	3242	2176		39.6	55
						55.8						87.0		
60	59.3	6.3	550	118.7	3174		52.9	83	430	3604	2611		43.5	60
						45.2						58.6		
65	62.2	6.7	494	122.5	3400		52.3	88	518	3918	2904		44.7	65
						34.4						41.0		
70	64.6	7.2	447	125.3	3572		51.0	89	607	4179	3109		44.4	70
						25.4						28.6		
75	66.5	7.6	408	127.2	3699		49.3	86	693	4392	3252		43.4	75
						17.2						18.8		
80	67.9	7.9	377	128.4	3785		47.3	83	776	4561	3346		41.8	80
						10.4						11.0		
85	68.9	8.2	352	129.0	3837		45.1	78	854	4691	3401		40.0	85
						5.2						3.8		
90	69.5	8.5	331	129.1	3863		42.9	67	921	4784	3420		38.0	90
						2.0						—2.0		
95	69.9	8.7	315	128.9	3873		40.8	52	973	4846	3410		35.9	95
						.8						—7.0		
100	70.2	8.8	302	128.7	3877		38.8	38	1011	4888	3375		33.8	100

WHITE BIRCH

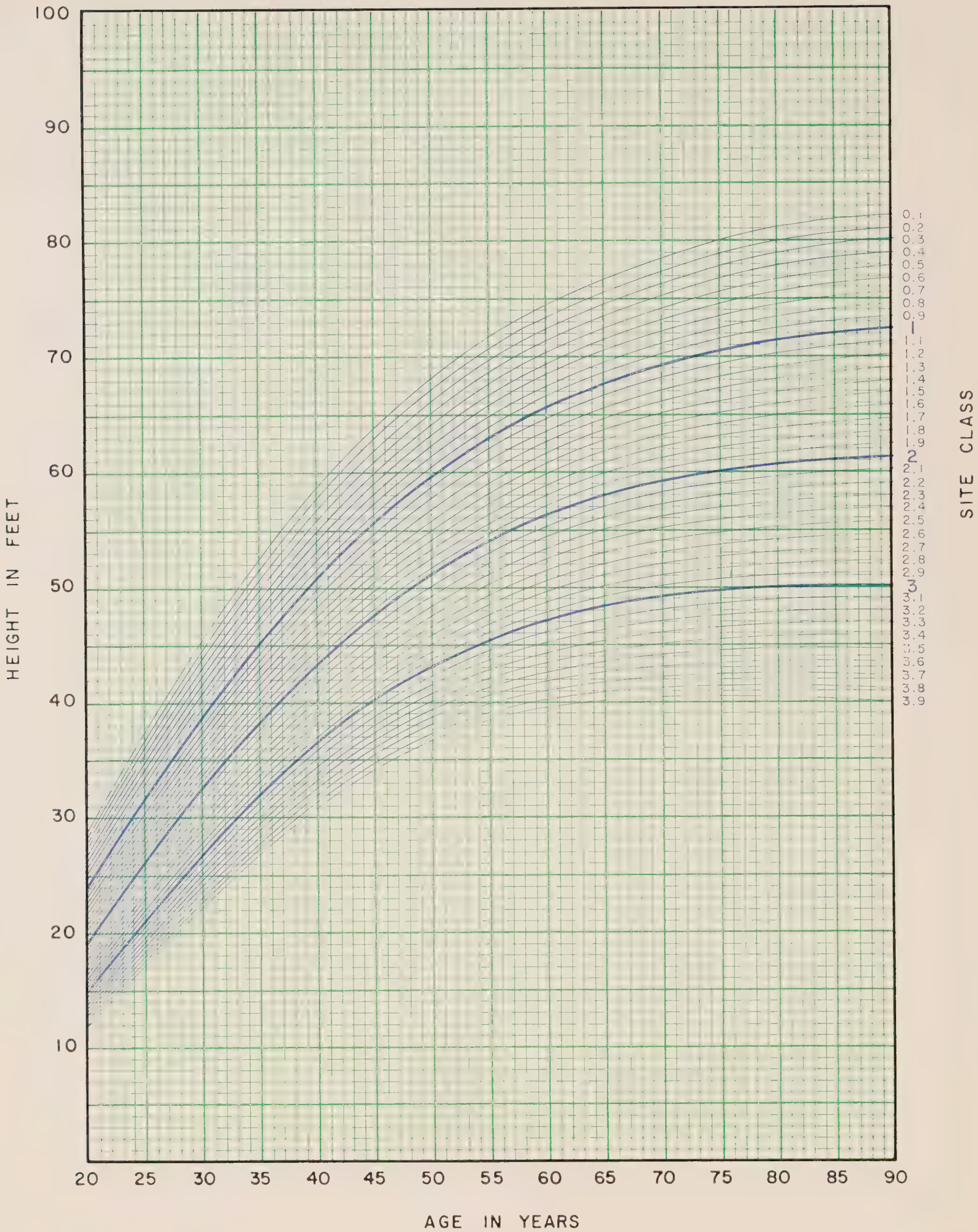


FIGURE 14

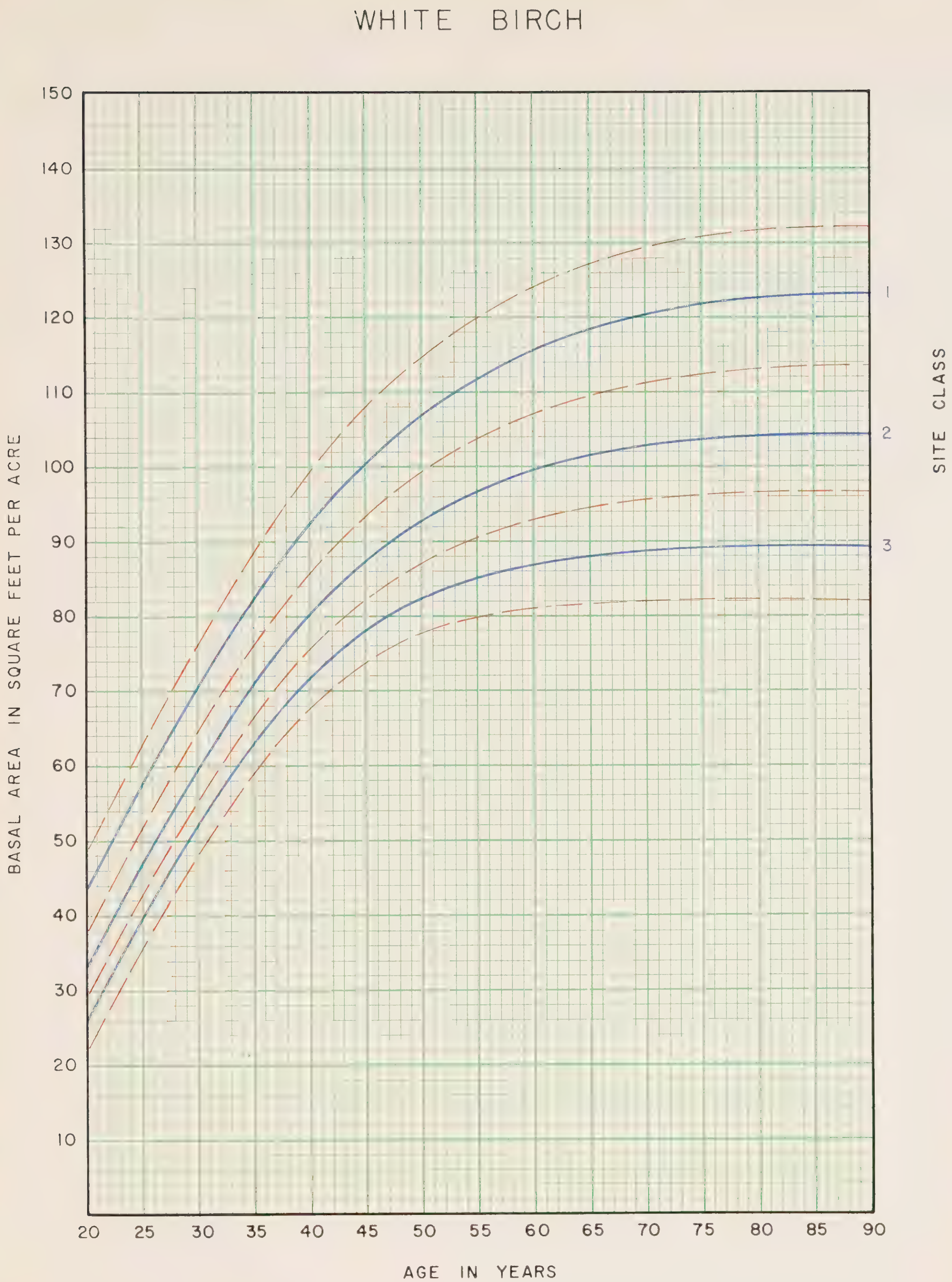

WHITE BIRCH
BASAL AREA IN SQUARE FEET PER ACRE
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
AGE IN YEARS
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
SITE CLASS
1
2
3

Figure 15

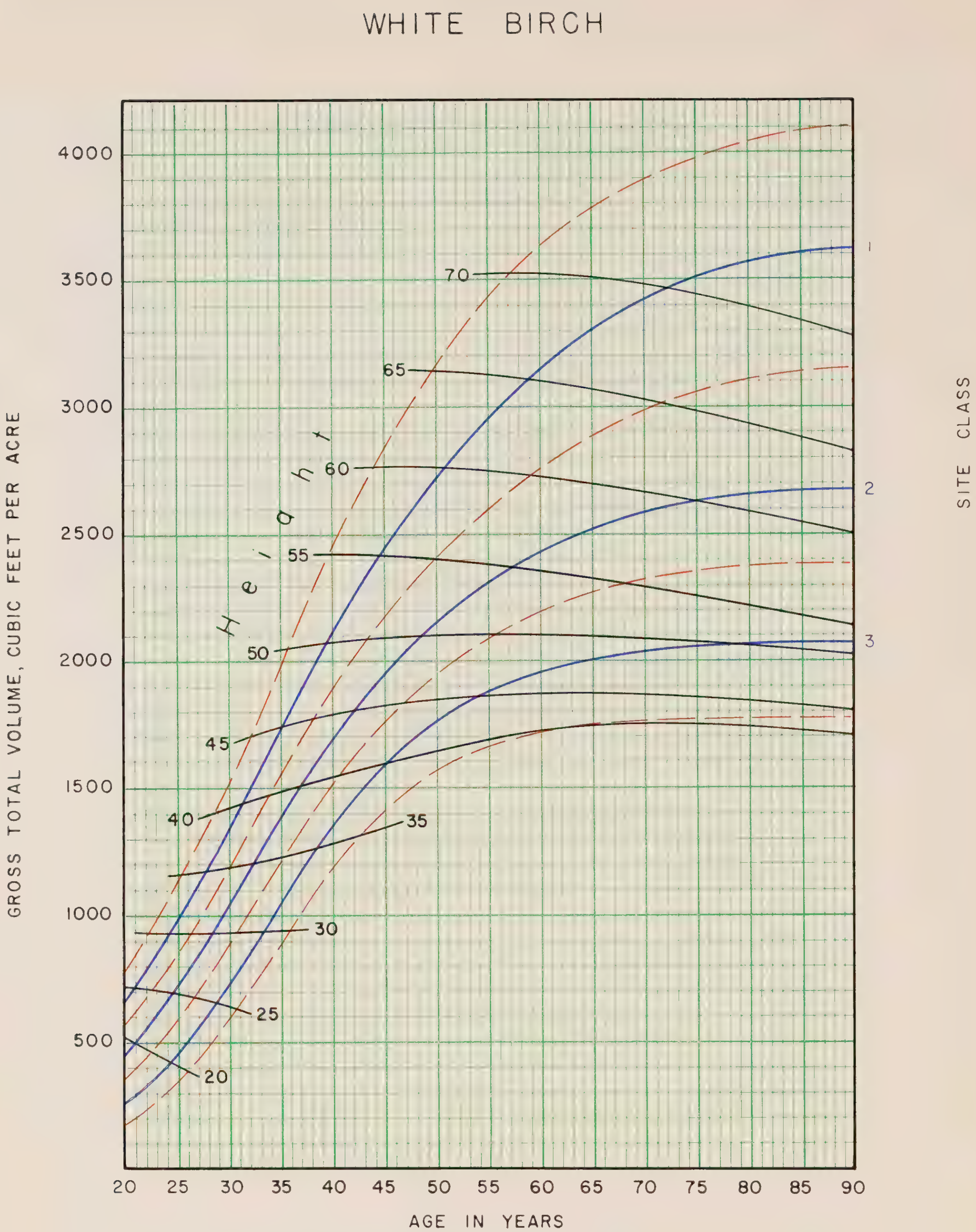

WHITE BIRCH
4000
3500
3000
2500
2000
1500
1000
500
GROSS TOTAL VOLUME, CUBIC FEET PER ACRE
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
AGE IN YEARS
Height
70
65
60
55
50
45
40
35
30
25
20
1
2
3
SITE CLASS

FIGURE 16

Table 12
WHITE BIRCH
SITE-CLASS 1

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	23.7	1.9	2173	43.3	653		32.6			653	21		1.0	20
						65.0						56.6		
25	31.3	2.6	1503	57.3	978		39.1	58	58	1036	304		12.2	25
						71.8						64.8		
30	38.4	3.4	1113	70.5	1337		44.6	71	129	1466	628		20.9	30
						77.2						68.0		
35	44.8	4.2	866	82.4	1723		49.2	79	208	1931	968		27.7	35
						75.6						68.8		
40	50.5	4.9	708	92.4	2101		52.5	83	291	2392	1312		32.8	40
						68.4						66.0		
45	55.4	5.5	603	100.4	2443		54.3	86	377	2820	1642		36.5	45
						52.2						56.8		
50	59.5	6.1	530	106.7	2704		54.1	85	462	3166	1926		38.5	50
						48.4						48.2		
55	62.9	6.6	474	111.7	2946		53.6	82	544	3490	2167		39.4	55
						40.0						38.6		
60	65.6	7.1	426	115.6	3146		52.4	79	623	3769	2360		39.3	60
						32.0						31.2		
65	67.7	7.5	385	118.5	3306		50.9	76	699	4005	2516		38.7	65
						24.0						26.2		
70	69.4	7.9	350	120.5	3426		48.9	71	770	4196	2647		37.8	70
						17.4						21.4		
75	70.6	8.4	319	121.8	3513		46.8	67	837	4350	2754		36.7	75
						12.0						16.4		
80	71.5	8.8	293	122.6	3573		44.7	62	899	4472	2836		35.4	80
						7.6						13.4		
85	72.1	9.1	270	123.0	3611		42.5	57	956	4567	2903		34.2	85
						3.8						6.0		
90	72.5	9.5	250	123.2	3630		40.3	51	1007	4637	2933		32.6	90

Table 13

WHITE BIRCH

SITE-CLASS 2

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	18.7	1.4	3028	33.0	448		22.4			448				20
						54.2								
25	25.7	2.1	2033	46.8	719		28.8	38	38	757	30		1.2	25
						62.4						45.2		
30	32.2	2.7	1533	59.7	1031		34.4	51	89	1120	256		8.5	30
						69.4						52.0		
35	38.0	3.3	1206	71.2	1378		39.4	63	152	1530	516		14.7	35
						61.8						52.8		
40	43.1	3.9	977	80.4	1687		42.2	71	223	1910	780		19.5	40
						51.8						48.4		
45	47.4	4.4	819	87.5	1946		43.2	75	298	2244	1022		22.7	45
						40.8						43.0		
50	51.0	4.9	710	92.8	2150		43.0	71	369	2519	1237		24.7	50
						31.8						37.2		
55	53.9	5.3	635	96.7	2309		42.0	63	432	2741	1423		25.9	55
						24.6						30.8		
60	56.2	5.6	583	99.5	2432		40.5	54	486	2918	1577		26.3	60
						18.4						23.2		
65	58.0	5.9	543	101.5	2524		38.8	45	531	3055	1693		26.0	65
						13.2						17.0		
70	59.3	6.1	513	102.8	2590		37.0	38	569	3159	1778		25.4	70
						8.4						12.2		
75	60.2	6.2	490	103.6	2632		35.1	33	602	3234	1839		24.5	75
						5.6						7.8		
80	60.8	6.4	471	104.0	2660		33.2	28	630	3290	1878		23.5	80
						3.4						4.2		
85	61.2	6.5	456	104.2	2677		31.5	25	655	3332	1899		22.3	85
						1.8						1.2		
90	61.4	6.6	442	104.3	2686		29.8	23	678	3364	1905		21.2	90

Table 14

WHITE BIRCH

SITE-CLASS 3

Age in Years	Height in Feet	D.B.H. in Inches	Trees per Acre	Basal Area in Sq. Ft.	Gross Total Volume, Cubic Feet per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Suppressed Trees: Volume	Cumulative	Total Production	Gross Merch. Vol., Cu. Ft. per Acre: Main Stand: Volume	C.A.I.	M.A.I.	Age in Years
20	14.7	1.1	3842	25.7	260		13.0			260				20
						37.0								
25	20.6	1.7	2462	39.5	445		17.8	23	23	468				25
						55.8								
30	26.5	2.3	1838	52.1	724		24.1	36	59	783	59		2.0	30
						63.2						40.6		
35	31.8	2.8	1440	63.0	1040		29.7	48	107	1147	262		7.5	35
						60.8						44.4		
40	36.3	3.4	1163	71.7	1344		33.6	57	164	1508	484		12.1	40
						48.2						38.4		
45	40.1	3.8	966	78.1	1585		35.2	63	227	1812	676		15.0	45
						34.2						32.8		
50	43.1	4.3	827	82.3	1756		35.1	64	291	2047	840		16.8	50
						23.6						27.6		
55	45.4	4.6	732	85.0	1874		34.1	55	346	2220	978		17.8	55
						16.0						22.4		
60	47.1	4.9	668	86.8	1954		32.6	45	391	2345	1090		18.2	60
						10.2						17.8		
65	48.3	5.1	625	88.0	2005		30.8	35	426	2431	1179		18.1	65
						6.4						13.2		
70	49.2	5.2	596	88.7	2037		29.1	26	452	2489	1245		17.8	70
						4.0						9.6		
75	49.8	5.3	577	89.1	2057		27.4	20	472	2529	1293		17.2	75
						2.4						6.2		
80	50.1	5.4	563	89.3	2069		25.9	14	486	2555	1324		16.6	80
						1.2						3.0		
85	50.3	5.4	553	89.4	2075		24.4	10	496	2571	1339		15.8	85
						0.6						0.2		
90	50.3	5.5	546	89.4	2078		23.1	7	503	2581	1340		14.9	90

A jack pine stand with an average height of 66.7 feet at the age of 80 years, is growing on site-class 1.5, which is halfway between good and average growth condition. It has 105.7 sq. ft. of basal area, indicating stocking 0.9. Gross total volume of 3,172 cu. ft. per acre produces, at this age, only 5.6 cubic feet per year. Gross merchantable volume, 2,844 cu. ft. per acre, shows an annual increment of 7.1 cu. ft., or only 0.25 per cent.

Hon. Clare E. Mapledoram

Minister

F. A. MacDougall

Deputy Minister

Report No. 25

CULL STUDIES

Forest Resources Inventory

— 1958 —

Division of Timber

Ontario Department of Lands and Forests

A Survey of a Pathological Condition in the Forests of Ontario

—1958—

by

Z. J. R. MORAWSKI
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Division of Timber

Ontario Department of Lands and Forests

ABSTRACT

• An extensive province-wide survey was made for the purpose of obtaining cull factors for the main commercial tree species in Ontario, so that more accurate inventories of merchantable volumes could be readily calculated. In order to give the cull factors a wider application in forest management, they were related to age of trees and, where possible, to site.

One-tenth acre sample plots, selectively chosen in potentially operable stands, were clear cut. Volumes of sound and decayed wood and of other defects were computed by scaling, and by the use of Reineke tree measurement sheets.

For all tree species cull was closely related to age, increasing as trees become older. Site, expressed by available soil moisture, had a greater effect on cull in conifers, particularly black spruce, *Picea mariana* (Mill.) BSP., and jack pine, *Pinus Banksiana* Lamb., than in hardwoods.

In black spruce cull was generally low, averaging 4 per cent of the gross merchantable volume at 140 years. Cull increased with site quality, but the higher productivity on the better sites more than off-set the higher cull on those sites.

Jack pine cut for pulpwood at a rotation of 50 to 60 years had an insignificant degree of cull — about one per cent. When grown to a rotation of 100 years to obtain other forest products, the cull factor may be expected to vary from 3 per cent in northeastern Ontario to 9 per cent in the northwestern part of the Province. For jack pine 80 years of age and over, trees on dry sites generally had a higher degree of cull than those on moderately fresh and fresh sites.

Aspen, *Populus tremuloides* Michx., utilized for pulpwood at a rotation of 60 years had a cull factor of about 10 per cent, but if a rotation of 100 years is considered to obtain other forest products, cull may be expected to increase to approximately 20 per cent. No evidence was obtained to indicate that the soil moisture had any influence on the degree of cull, but there was some indication that a higher degree of cull may be expected in trees growing on poor-quality sites.

For sugar maple, *Acer saccharum* Marsh., and yellow birch, *Betula lutea* Michx. f., a close relationship was found to exist between tree diameter and age. Thus, for ease in field use, cull was related to diameter at breast height rather than to age. While height-diameter relationship for both species was similar in the Algoma and Algonquin areas, where these species were sampled, tree age and the degree of cull at a given diameter were different in the two areas. A sugar maple tree 18 inches D.B.H. averaged 217 years of age in the Algoma area and 155 years in the Algonquin area. The comparable cull for sawlogs was 36 and 30 per cent respectively. Yellow birch of the same D.B.H. averaged 200 and 170 years in these two areas, and the cull for sawlogs was 42 and 34 per cent respectively. Soil moisture did not appear to have any effect on cull in these two species. It is possible that other factors, particularly disturbances and changes in the stands caused by past logging, are important.

Thirteen other tree species were sampled to a lesser degree. While the results are not as reliable, they are, nevertheless, indicative of the amount of cull that might be expected in these species at a given age or diameter.

A tree decadence classification, based on visible external defects, was used to estimate cull in standing tolerant hardwoods. A comparison of these estimates with the actual cull from the felled trees indicated that the method was satisfactory so long as experienced personnel were used.

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FIG. 1. — *Map of Ontario showing forest ecological sections as adapted from Halliday (8) for the inventory programme, and the locations of field sampling. Hatched line is boundary between the Boreal and Great Lakes-St. Lawrence Forest Regions. Each circle represents an area in which several plots were located.*

INTRODUCTION

● The preparation of forest management plans involves, among other considerations, a knowledge of the average annual depletion of volume in standing timber other than that brought about by planned cutting operations. This depletion includes losses caused by fire, insects and disease. With regard to disease, decay is the major factor associated with the depletion of volume, and has its greatest effect in mature and overmature stands.

Knowledge of the extent of losses attributed to decay and other defects, expressed in terms of reliable cull factors, is a necessary requirement of the present-day forest inventory. Furthermore, this knowledge will constitute a valuable contribution to forest management planning where it is possible to control these losses through silvicultural methods.

In recognition of the importance of these considerations, it was decided in March 1952 at a meeting of the Advisory Committee on Forest Entomology and Pathology, to undertake a series of surveys in the Province within the Federal-Provincial forest inventory programme. This was to be a joint project between the Division of Timber, Ontario Department of Lands and Forests, and the Forest Pathology Laboratory at Maple, Division of Forest Biology, Science Service, Canada Department of Agriculture, for the purpose of determining:

(a) cull factors for commercially important species;

(b) relation of cull to age and site;

(c) influence of cull on rotation age;

(d) the identity, frequency of occurrence, type of associated defect, and relative importance of the various fungi causing decay in the commercially important parts of living trees.

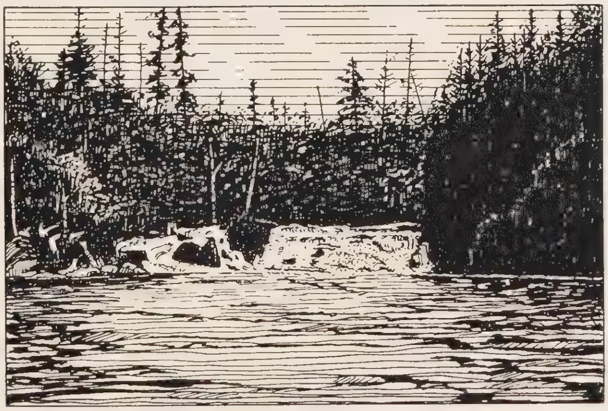
During the survey of the tolerant hardwood species, it was considered desirable also to develop:

(a) a tree decadence classification based on interpretation of the visible signs of defects, and

(b) a log-grading system applicable to the main tolerant hardwood species.

In this report, the results of the surveys are analysed and presented with a view to their direct application to forest management. The pathological aspects of the project, outlined above as objective (d), will be discussed in detail in separate papers prepared by the Forest Pathology Laboratory. Preliminary information indicating the importance of the types of decay and associated specific fungi available at present for some tree species was considered to have sufficient practical significance and general interest to be included as Appendix B of this report.

The Canada Department of Northern Affairs and National Resources has reimbursed to the Province one-half of the expenditures incurred in this survey, under the terms of an agreement pursuant to the provisions of the Canada Forestry Act.



METHODS

Variables Studied

• The amount of cull in living trees generally increases with tree age, and is probably influenced by several environmental factors. Therefore, in this study site quality, which was the only environmental factor recorded, and tree age are the two variables studied. From the practical or immediately useful aspects of the survey, age is considered the more important of these two variables because, in contrast with site, it is almost always recorded in inventory surveys. However, since site quality has a marked influence on productivity, and hence will play an increasingly greater role in management as time goes on, some attempt was made to investigate its effect on cull. It is for these reasons that site is not a controlled variable in analysing for the effect of age on cull, but age is controlled in analysing for the effect of site.

The broad ecological division of Ontario into forest regions and sections (8), used in the inventory programme, was also used in this project so that the investigation of the relation of cull to site factors could be made within a common ecological framework.

It is generally recognized that the complexity of forest site as a result of the inter-action of the varied component features, presents great difficulty in site classification. Because of limitations in time and staff, and in view of the objective of the work, a site classification in a study of this nature must be reduced to its simplest form.

The relation of height to age is recognized as one of the most reliable measures of the cumulative effect of site on tree growth, and at the same time is easy to determine in the field. If volumetric results were the only objective of this project, the height-age method would have been used exclusively. However, since the study also deals directly with pathological aspects, it was felt that a site classification based on physiographic features would provide a better basis for examining the cull-site relationship. Therefore, the basic site classification developed by the Research Division of the Ontario Department of Lands and Forests (9) was adopted, but reduced to only one variable — available soil moisture — in order to facilitate its application to this project. Although there are several site variables which may influence the degree of cull, the available soil moisture is undoubtedly one of the most important, since it is an expression of the inter-action of several other site features, such as texture and depth of soil and general drainage conditions.

In the case of sugar maple* and yellow birch in the Algonquin Ecological Section, it was possible to take an additional site variable into consideration, namely, landtype based on soil parent material. Sampling was confined to two major landtypes which have been defined and named by Hills (9) as:

(1) *Sherborne* — characterized by sandy tills derived from granitic bedrock materials, very low in bases;

(2) *Limerick* — characterized by sandy tills derived from basic igneous rocks low in bases or from schists and similar rich metamorphic rocks in which crystalline limestone may or may not be present.

In the Algoma Ecological Section the sampled stands of sugar maple — yellow birch were on granitic soils similar to those of the Sherborne landtype in the Algonquin Ecological Section.

In view of the complexity of the site factors involved, it is apparent that no definite conclusions as to the effect of site on cull can be expected. Some trends, however, have been observed in different species, and these are pointed out in the report in the hope that they may lead to further examination by research agencies.

In addition, the site classification based on average stand-height development was used, but was restricted to pure or nearly pure stands of jack pine, black spruce, and aspen. This classification was presented in Report No. 24, published by the Timber Management Division, Ontario Department of Lands and Forests (12).

Field Procedure

Almost all of the forested lands in Ontario form a part of two ecological Forest Regions as defined by Halliday (8): the Boreal and the Great Lakes-St. Lawrence Forest Regions. Consequently, sampling was confined to those two broad ecological areas, with emphasis on the main commercial species of each region.

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* Appendix C contains a list of the scientific names of all tree species referred to in the report.

The field work was carried out by cruising parties organized by the Division of Timber, Ontario Department of Lands and Forests, and the over-all supervision of the project was assigned to a forester from the staff of this Division. Personnel were also provided by the Forest Pathology Laboratory at Maple, for the purpose of collecting samples of decay, culturing and identification of the causal fungi.

Periodic assistance in identification of lesser known fungi was provided by the Botany and Plant Pathology Laboratory, Ottawa; and in classification of forest sites by the site specialists from the Division of Research, Ontario Department of Lands and Forests. Basic techniques developed by the Forest Pathology Laboratory in previous pathological investigations were adopted for and modified to the requirements of this project.

The field work, which extended over six years, 1952 to 1957, in 42 separate localities in the Province (Fig. 1), included 800 sample plots. On these sample plots 22,739 trees were felled, bucked, and examined in detail (Table 1).

Sampling units were square 0.1 acre plots, selectively chosen in stands which were potentially operable. Careful consideration was given to sampling average conditions of composition, age, and density in each stand. As far as possible, site conditions were uniform within each sample plot. An effort was made to sample each species throughout several age classes and site conditions in the ecological sections where the survey was carried out.

Detailed descriptions of forest types, soil, topography and ground cover, as well as information concerning the history of sampled forest types, were recorded. Data concerning soil moisture conditions were obtained by digging a soil pit in each sample plot. In the field, the soil moisture for each plot was classified into one of 9 moisture classes expressed by the numerals from 0 to 8. However, in the analysis these classes were combined in most cases into site groups: dry (0–1), fresh (2–3), moist (4–5), and wet (6–8).

Table 1

Sample Trees, Summarized by Species and Ecological Sections

Ecological Section	No. of Sample Plots	Number of Sample Trees																		
		Black Spruce	White Spruce	Jack Pine	Balsam Fir	Aspen	White Birch	Sugar Maple	Yellow Birch	Basswood	Beech	Black Ash	Hemlock	Ironwood	White Cedar	Black Cherry	Red Maple	Red Oak	White Elm	Total
Algonquin	362	.....	58	.....	200	115	.....	3,138	1,177	140	393	112	370	137	86	22	52	35	62	6,097
Algoma	79	.....	25	.....	49	.....	.....	784	241	.....	.....	.....	17	20	30	....	14	7	....	1,187
Central Transition	57	826	61	902	101	462	201	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	2,553
Clay Belt	70	1,784	158	479	217	593	113	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	3,344
Central Plateau	51	1,055	40	940	73	441	62	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	2,611
Superior	75	746	187	354	558	318	421	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	2,584
Western Transition	49	927	21	710	128	230	51	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	2,067
English River	57	931	14	902	62	299	88	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	2,296
Total	800	6,269	564	4,287	1,388	2,458	936	3,922	1,418	140	393	112	387	157	116	22	66	42	62	22,739

Each sample plot was clear-cut of all living trees 3.6 inches D.B.H. and over, at a stump height of one foot. Prior to felling, the D.B.H. of each tree was recorded and, in the case of tolerant hardwood trees of sawlog size, an estimate of cull percentage was made by interpreting the visible signs of defects (Tables 43 and 44, Appendix A). The purpose of this procedure in tolerant hardwoods was to investigate the possibility of obtaining a reliable method of estimating cull in standing trees during an inventory cruise. This was based on a study of similar nature in Minnesota (19), and modified to the requirements of this project.

After a tree was felled, the total height of the tree and the length of the clear bole were recorded. The tree was then cut, in the case of pulpwood into 8-foot sections up to 3.5 inches diameter inside bark at the top, and in the case of sawlogs into logs according to the specifications based on the official rules of the Northern Hemlock and Hardwood Manufacturers Association, U.S.A. (7), and modified to the requirements of some local sawlog operators in Ontario. Diameters inside bark of all sections, and of the portions of the cross-sections affected by decay, were measured to the nearest one-tenth of one inch. Stains and incipient and advanced forms of decay were recorded separately, a brief description of each decay and stain was made and, where possible, tentative identifications of fungi were made in the field. The extent of various forms and stages of decay was determined by resectioning the bolts into 4-foot or 2-foot lengths and, where necessary, by splitting the sections lengthwise. Measurements relating to age and growth-rate were taken on the stumps, and no estimate was made of total age. Therefore, all references to age in the report pertain to age at a stump height of one foot. Samples of each decay or stain encountered in each tree were collected and forwarded to the Forest Pathology Laboratory at Maple for the identification of causal fungi. All the foregoing measurements were recorded on Reineke graphic tree measurement sheets (4), and notes were taken on the external defects affecting log quality.

The felled timber was scaled according to the Ontario scaling regulations (13). Pulpwood was scaled in cubic feet and sawlogs were graded and scaled in both cubic and board feet, Ontario Log Rule.

A series of sawmill tests with tolerant hardwood sawlogs was conducted in co-operation with the Forest Products Laboratory, Forestry Branch, Canada Department of Northern Affairs and National Resources, Ottawa, and with sawmill operators. The purpose of these tests was to investigate and determine the applicability of the hardwood log-grading specifications adopted in this project.

Office Procedure

From each graphic field sheet, calculations of volume were made by planimetering the areas outlined on the sheet from the measurements made in the field, and then by converting these areas into volumes in cubic feet. This procedure produced the following data in cubic feet for each sample tree:

(1) gross total volume (top and stump included);
(2) gross merchantable volume (top and stump excluded);
(3) volume of decay (incipient and advanced, butt and trunk separately);
(4) net merchantable volume (decay excluded).

In addition, the result of scaling gave the following data for each tree in cubic feet for both pulpwood and sawlogs, and in board feet for sawlogs only:

(1) gross merchantable scaled volume;
(2) cull deductions;
(3) net merchantable scaled volume.

Thus, two sets of volume summaries have been prepared, the "computed" volumes, derived from the planimetering method, which are used in dealing with the pathological aspects of the project (Appendix B), and the scaled volumes which lead to the determination of cull factors for management purposes. In the tables showing basic field data in this report, except for those in Appendix B, only gross total volumes were "computed." Gross merchantable, cull and net merchantable volumes were derived by scaling, and the volumes of tops and stumps represent the difference between the gross total and the gross merchantable volumes.

For each sample plot, volumetric data from the tally sheets were summarized in tabular form by species and 20-year age classes. These summaries formed the basic material used for the subsequent analysis within any desired area, such as ecological unit, administrative district, management unit, or for any required group of sites. The relationship of cull to age within these areas or groups of sites is shown largely by graphic presentation. The curves

used were constructed and balanced, using Dwight's refinement method (5).

With the tolerant hardwoods, there is considerable difficulty in determining age in the course of inventory cruises, and therefore the summaries and graphs for these species were prepared showing the relation of cull to diameter at breast height, rather than to age. In addition, summaries showing the proportions of log grades obtained were included for tolerant hardwoods, thus giving information on quality of timber in the areas under investigation. Furthermore, the results of cull estimates in standing trees, using the tree decadence classification, were summarized and compared to the calculated per cent of cull obtained through the scaling procedure, thus providing a check on the practical application of estimating cull in standing trees.

Mixedwood stand, Superior Ecological Section.

THE BOREAL FOREST REGION

Forest Description

● The bulk of the forested lands of northern Ontario are covered by the Boreal Forest Region. Long winters, a short growing period of less than 100 days, and comparatively low precipitation, increasing from west to east, are the main climatic characteristics of the region.

The forest cover is primarily coniferous, with black spruce and jack pine forming extensive pure or nearly pure stands, the former species on moister and the latter on drier sites. White and black spruce, balsam fir, jack pine, white birch and aspen, in varying proportions, form the mixedwood stands in this region. These stands occur generally on fresh sites, and occasionally on dry and moist sites. Hardwood stands of aspen and white birch are also common. Most of the stands in northern Ontario have come in following extensive forest fires which have influenced the composition, extent, and age-class distribution of forest cover types now found in this area. Fires have also had an effect on the degree of cull in stands, either as a factor causing deterioration of site or through direct damage to residual trees.

Black spruce and jack pine, which are the principal commercial species of this region, were sampled intensively; sampling of white spruce, balsam fir, white birch, and aspen was considerably less intense.

The main species of this region are, at present, used almost exclusively for pulpwood production and sustain the very important pulp and paper industry throughout northern Ontario.

The cull survey took place in the following ecological sections of the Boreal Forest Region: Central Transition, Clay Belt, Central Plateau, Superior, Western Transition, and English River. Sampling in the Superior Section was limited to one area only, the upper Black Sturgeon watershed, south of Lake Nipigon. Sharpe and Brodie (14) regarded this latter area as being sufficiently different to warrant the establishment of a separate subsection, the Nipigon Extension of the Clay Belt. Therefore, the data obtained in this specific area may not be representative of the Superior Section as a whole.

Black Spruce

Black spruce is the principal species within the Boreal Forest Region of northern Ontario, in both volume of standing timber and in economic value. Its economic importance is emphasized by the fact that this species not only makes the best quality newsprint, but also forms the major part of the timber cut.

Although the extensive pure, or nearly pure, black spruce stands mostly occupy poorly drained areas, some pure stands of limited size can also be found on drier sites. In general, however, on slopes and better-drained areas black spruce occurs in association with jack pine, aspen, white birch, white spruce, and balsam. Mixedwood stands involving these species in varying proportions are prevalent throughout the whole of the Boreal Forest in Ontario. Mixed stands of black spruce and jack pine are common, particularly in the Central Transition, Central Plateau, and Western Transition Ecological Sections.

Since black spruce is used almost entirely for pulpwood production, all trees sampled in the course of this survey were scaled as pulpwood.

The total sample amounted to 6,269 trees, which were encountered in 257 sample plots, of which 76 were established in pure, or nearly pure, black spruce stands.

As is pointed out in the introduction, some preliminary information concerning the types of decay in black spruce and of the associated fungi are provided in Appendix B, where Table 45 gives the proportions of the different types and stages of decay, and Table 46 shows the specific fungi identified with these types of decay.

Age

Variations in degree of cull among the different ecological sections were minor, and therefore all samples were combined and summarized in one table showing the volumetric relationship of cull to age (Table 2). These data, recalculated on the basis of the average tree for each age class, have been used for construction of the curves in Figs. 2 and 3. The data derived from these curves are tabulated by 10-year age classes in Table 3, for ready application in management work.

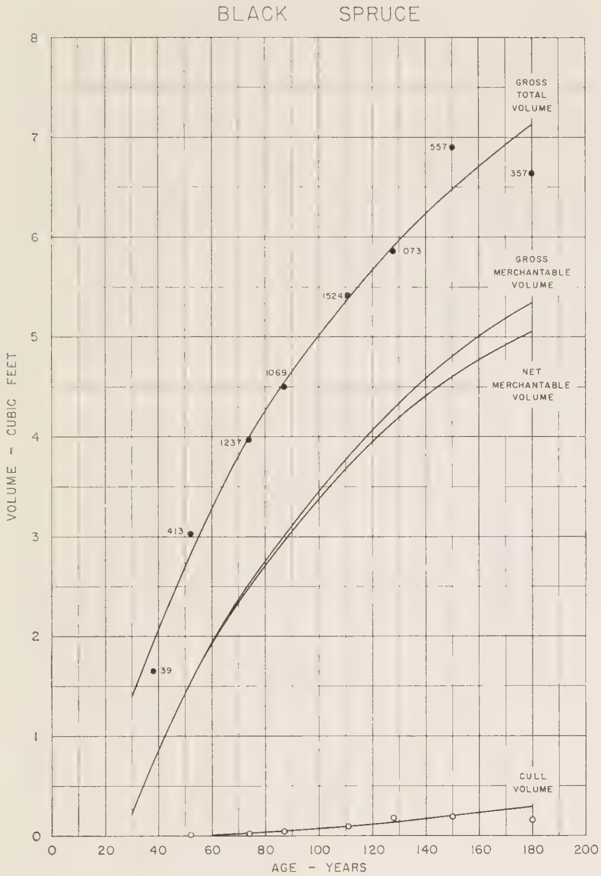


FIG. 2. — *Average volume per tree in relation to age. Number of sample trees are shown for each age class. All sites combined — Boreal Forest Region.*

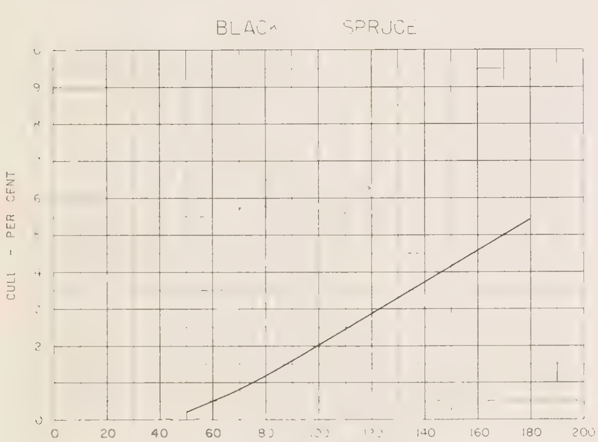


FIG. 3. — *Cull as a percentage of the gross merchantable volume in relation to age. Average of all sites — Boreal Forest Region.*

As may be observed in Table 3 and Fig. 3, the degree of cull, increasing steadily with age, is insignificant up to 80 years, and still does not exceed 5 per cent at 170 years.

Site

In order to determine the influence of site on the degree of cull in black spruce, four main site groups based on soil moisture were used, namely, dry, fresh, moist, and wet. The effect of site is clearly shown in Fig. 4, where the degree of cull is related to both age and site.

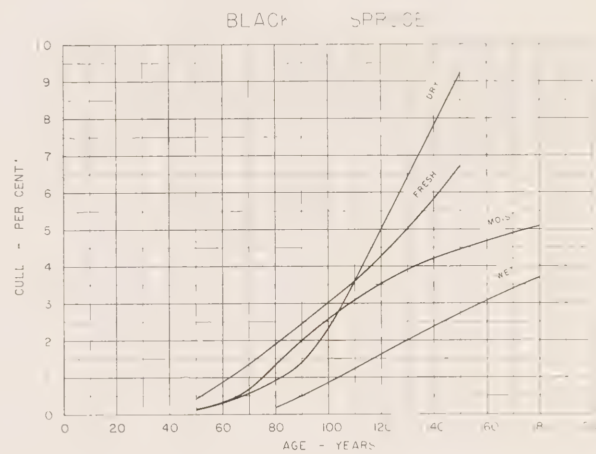


FIG. 4. — *Cull per cent in relation to age by soil moisture groups. Boreal Forest Region.*

It appears that trees on the drier sites have a higher degree of cull, and that the cull is progressively lower on the wetter sites. Since, however, the actual differences in cull on the dry, fresh, and moist sites up to 120 years of age are quite small, it was decided to combine these in order to provide for practical use, only two major groups, namely, upland and lowland sites (Fig. 5). It can be readily seen that a definitely higher degree of cull may be expected in black spruce growing on upland sites than on lowland flats with impaired drainage. However, black spruce trees on upland sites, particularly on fresh and moist sites, generally reach a larger size, both in diameter and height. Therefore, in spite of a higher percentage of cull, the average tree has a higher net merchantable volume on these sites (Tables 4, 5, and Fig. 6).

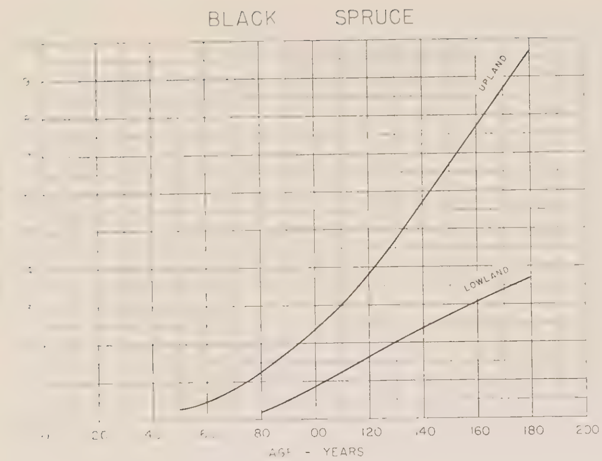


Fig. 5. — *Cull per cent in relation to age for upland and lowland (wet) sites. Boreal Forest Region.*

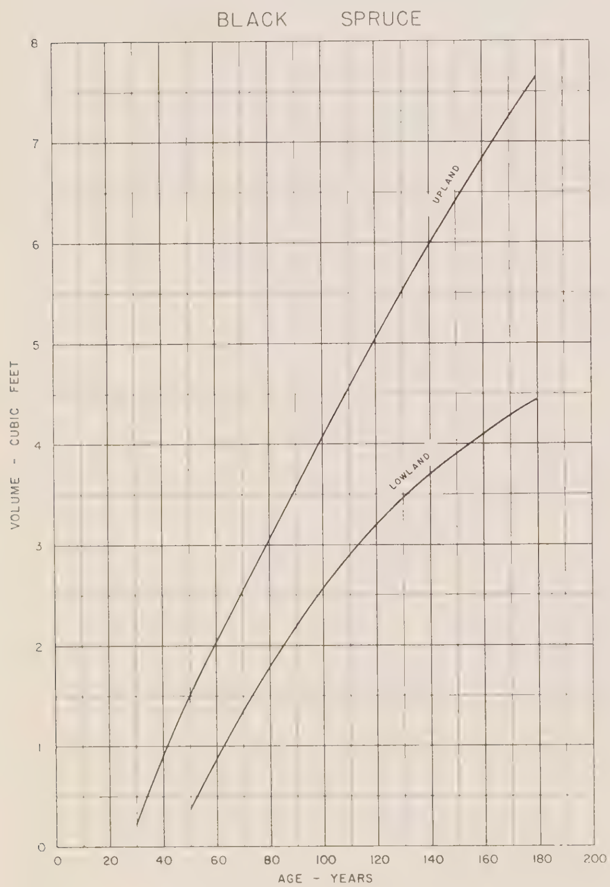


Fig. 6. — *Net merchantable volume per tree in relation to age for upland and lowland (wet) sites. Boreal Forest Region.*

Other characteristics of site — such as history of stands, nutrient level, and depth of soil — may also influence the degree of cull in black spruce, and should be considered when a more detailed investigation of cull is undertaken in any specific area.

The degree of cull in black spruce was also analysed with respect to the site classes based on average stand height development, as introduced in Report No. 24 on growth and yield studies (12). It was found that the degree of cull increases with the quality of site, as shown in Fig. 7; this, however, is more than offset by the higher production on better sites. It should be pointed out that the better sites (Site-class 1) of the growth and yield classification, correspond in general to the fresh, moist, and the best of the wet sites. The medium sites (Site-class 2), on the other hand, are largely comparable to the wet sites with poor drainage.

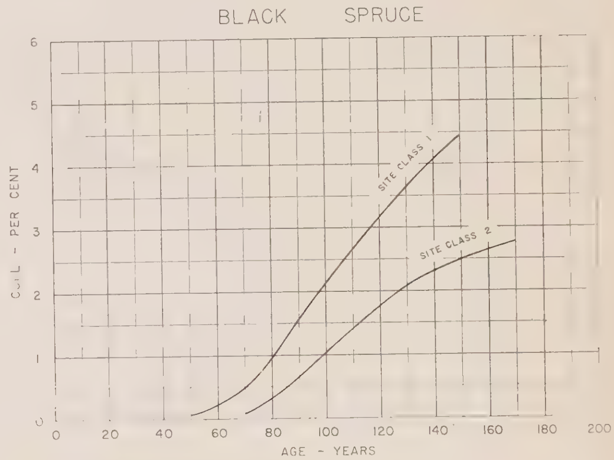


Fig. 7. — *Cull per cent in relation to age by sites classified according to stand height-age development. Boreal Forest Region.*

Rotation

Because of the small degree of cull in mature black spruce, the influence of cull on the rotation is of minor importance. However, stocking of black spruce stands becomes poorer as stand age increases, and this will have a definite effect on the rotation. It is estimated that the rotation of approximately 110 years based on normal stocking of black spruce stands, classified as site-classes 1 and 2 of the growth and yield studies (12), may be shortened by as much as fifteen years if the combined effect of cull and poorer stocking is taken into consideration.

Table 2—BLACK SPRUCE

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Vol.
21–40	39	38	33	4.2	64.92	46.88	18.04	....	18.04	72.2	....
41–60	413	52	40	5.2	1,249.80	550.35	699.45	6.18	693.27	44.0	0.9
61–80	1,237	74	45	5.6	4,910.77	1,796.95	3,113.82	23.84	3,089.98	36.6	0.8
81–100	1,069	87	49	5.8	4,812.37	1,600.65	3,211.72	39.56	3,172.16	33.3	1.2
101–120	1,524	111	50	6.2	8,259.86	2,457.99	5,801.87	140.39	5,661.48	29.8	2.4
121–140	1,073	128	52	6.4	6,288.95	1,771.39	4,517.56	194.78	4,322.78	28.2	4.3
141–160	557	150	54	6.9	3,843.50	962.19	2,881.31	108.93	2,772.38	25.0	3.8
161+	357	180	53	7.1	2,371.34	595.80	1,775.54	59.47	1,716.07	25.1	3.3
Total	6,269	......	....	....	31,801.51	9,782.20	22,019.31	573.15	21,446.16	......	....
Average	....	......	....	....	....	....	....	....	....	30.8	2.6

Table 3—BLACK SPRUCE

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	27	4.5	1.40	1.18	0.22	......	0.22	84.3	..
40	33	4.8	2.07	1.20	0.87	......	0.87	58.0	..
50	38	5.1	2.70	1.27	1.43	......	1.43	47.0	0.2
60	42	5.3	3.28	1.33	1.95	0.01	1.94	40.5	0.5
70	45	5.5	3.81	1.44	2.37	0.02	2.35	37.8	0.8
80	47	5.7	4.26	1.51	2.75	0.03	2.72	35.4	1.1
90	49	5.9	4.65	1.54	3.11	0.05	3.06	33.1	1.6
100	50	6.0	5.01	1.56	3.45	0.07	3.38	31.1	2.0
110	50	6.2	5.35	1.58	3.77	0.09	3.68	29.5	2.4
120	51	6.3	5.67	1.61	4.06	0.11	3.95	28.4	2.7
130	52	6.5	5.96	1.62	4.34	0.14	4.20	27.2	3.2
140	52	6.6	6.22	1.64	4.58	0.17	4.41	26.4	3.7
150	53	6.8	6.48	1.67	4.81	0.20	4.61	25.8	4.2
160	53	6.9	6.71	1.70	5.01	0.23	4.78	25.3	4.6
170	54	7.1	6.92	1.74	5.18	0.26	4.92	25.1	5.0
180	54	7.2	7.13	1.78	5.35	0.29	5.06	25.0	5.4

Table 4—BLACK SPRUCE

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

UPLAND SITES — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet					Percentage	
			Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	29	4.5	1.41	1.19	0.22	......	0.22	84.4	....
40	35	4.9	2.09	1.22	0.87	......	0.87	58.4	....
50	39	5.1	2.79	1.29	1.50	......	1.50	46.2	0.3
60	43	5.4	3.42	1.39	2.03	0.01	2.02	40.6	0.5
70	46	5.6	4.05	1.49	2.56	0.02	2.54	36.8	0.8
80	48	5.8	4.67	1.58	3.09	0.04	3.05	33.8	1.3
90	50	6.1	5.27	1.64	3.63	0.07	3.56	31.1	1.9
100	52	6.3	5.87	1.70	4.17	0.10	4.07	29.0	2.4
110	53	6.5	6.48	1.78	4.70	0.14	4.56	27.5	3.0
120	55	6.8	7.08	1.84	5.24	0.20	5.04	26.0	3.8
130	56	7.0	7.67	1.88	5.79	0.27	5.52	24.5	4.7
140	57	7.2	8.27	1.94	6.33	0.36	5.97	23.5	5.7
150	57	7.5	8.84	1.97	6.87	0.46	6.41	22.3	6.7
160	58	7.7	9.42	2.01	7.41	0.57	6.84	21.3	7.7
170	59	8.0	9.97	2.02	7.95	0.69	7.26	20.3	8.7
180	59	8.2	10.50	2.03	8.47	0.82	7.65	19.3	9.7

Table 5—BLACK SPRUCE

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

LOWLAND (WET) SITES — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet					Percentage	
			Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	25	3.4	1.12	1.12	......	......	......	100.0	...
40	31	3.9	1.57	1.57	......	......	......	100.0	...
50	36	4.4	2.01	1.63	0.38	......	0.38	81.1	...
60	39	4.7	2.44	1.57	0.87	......	0.87	64.3	...
70	42	5.0	2.85	1.50	1.35	......	1.35	52.6	...
80	44	5.2	3.25	1.45	1.80	......	1.80	44.6	0.2
90	46	5.5	3.62	1.42	2.20	0.01	2.19	39.2	0.5
100	47	5.7	3.99	1.40	2.59	0.02	2.57	35.1	0.8
110	48	5.9	4.34	1.40	2.94	0.04	2.90	32.3	1.4
120	49	6.0	4.67	1.41	3.26	0.06	3.20	30.2	1.8
130	49	6.2	5.00	1.46	3.54	0.07	3.47	29.2	2.0
140	50	6.4	5.30	1.51	3.79	0.09	3.70	28.5	2.4
150	50	6.5	5.57	1.56	4.01	0.11	3.90	28.0	2.7
160	51	6.6	5.82	1.59	4.23	0.13	4.10	27.3	3.1
170	52	6.8	6.07	1.64	4.43	0.15	4.28	27.0	3.4
180	52	6.9	6.30	1.69	4.61	0.17	4.44	26.8	3.7

White Spruce

This species occurs in the Boreal Forest Region as a scattered admixture in mixedwood stands, in association with jack pine, black spruce, balsam fir, white birch, and poplar. No pure, or nearly pure, stands of white spruce were encountered during the survey. In the Algoma and Algonquin Ecological Sections of the Great Lakes—St. Lawrence Forest Region, white spruce also occurs as a scattered component in the tolerant hardwood stands of sugar maple and yellow birch; data on white spruce in this region will be found on page 74.

Owing to this scattered distribution, the total sample of white spruce, amounting to only 481 trees, was too small and too erratic to enable a proper examination and analysis of cull with respect to different site conditions and age. To improve the sample, it would have been necessary to increase considerably the number of sample plots in those mixed stands in which white spruce appeared. Since the limited character of this project does not at this time allow an increase in sampling, it is suggested that, for practical purposes in pulpwood operations, cull factors calculated for black spruce may be used for both white and black spruce. This is justified by the similarity of the average cull factors calculated separately for white and black spruce, which amount to 3.6 and 2.6 per cent respectively.

It is pointed out that the majority of sampled trees did not exceed the age of 140 years, and therefore pertain largely to trees of pulpwood size. It is assumed that older trees of larger size would probably be used as sawlogs, and cull would include other defects in addition to decay. In this case, the over-all percentage of cull in white spruce would be higher than is indicated by the available data.

The preliminary data with reference to the types of decay, and to the associated specific fungi, are provided in Tables 47 and 48 of Appendix B.

Age

Table 6 shows the volumetric relationship of cull to age for white spruce trees sampled in the Boreal Forest Region. It will be seen that the percentages of cull shown in this table are very poorly correlated with age, and therefore no table of curved values is included.

Since, however, white spruce is a sufficiently important species to warrant further investigations, it is suggested that additional data be collected to provide more detailed information on the occurrence of cull for management purposes.

Site

As has already been stated, no analysis of cull with respect to site was possible because of insufficient data collected during the survey. However, since white spruce occurs predominantly on upland sites, an investigation of the influence of site on cull would be limited to dry, fresh, and moist sites.

Table 6—WHITE SPRUCE

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	2	39	23	4.1	2.33	1.63	0.70	....	0.70	70.0	
41–60	68	51	38	5.8	261.55	88.15	173.40	0.97	172.43	33.7	0.6
61–80	113	73	46	7.0	809.44	187.60	621.84	7.80	614.04	23.2	1.3
81–100	81	92	49	7.9	759.43	155.09	604.34	21.42	582.92	20.4	3.5
101–120	160	111	53	8.3	1,561.17	311.39	1,249.78	41.02	1,208.76	19.9	3.3
121–140	43	128	61	10.9	936.11	127.67	808.44	18.39	790.05	13.6	2.3
141–160	8	143	74	12.9	255.94	30.45	225.49	6.68	218.81	11.9	3.0
161+	6	190	84	17.7	284.17	30.09	254.08	43.65	210.43	10.6	17.2
Total	481	......	....	......	4,870.14	932.07	3,938.07	139.93	3,798.14		
Average	......	......	....	......	....	....	....	....	....	19.1	3.6

Jack Pine

Economically, jack pine is the second most important species occurring within the Boreal Forest Region of northern Ontario. It occupies extensive areas, either in the form of pure, or nearly pure stands, or in mixed stands, in association with black and white spruce, balsam fir, aspen, and white birch. Extensive jack pine and jack pine-black spruce stands are common, particularly in the Central Transition, Central Plateau, and Western Transition Ecological Sections.

Jack pine is utilized for various forest products, such as pulpwood, poles, ties, and sawlogs. At present, however, jack pine is used primarily for pulpwood, and it was therefore scaled as such in the course of this project.

The total sample of jack pine consists of 4,287 trees encountered in 189 plots, of which 132 plots were established in pure, or nearly pure, stands.

Preliminary information concerning the pathological phase of the survey is given in Appendix B, where Table 49 shows the proportions of the various types and stages of decay, and Table 50 the specific fungi associated with these types of decay.

Age

Samples of jack pine collected in different ecological sections were combined and are summarized in Table 7, showing the volumetric relationship of cull to age. This information, recalculated on the basis of the average tree for each age class, constituted the basic data for construction of the curves in Figs. 8 and 9. The data derived from these curves were tabulated by decades in Table 8 for management use. The fact that cull increases with age is well illustrated in Table 8 and Fig. 9.

The degree of cull for all sites combined varied noticeably in different ecological sections (Table 9). Upon grouping the ecological sections into eastern, central, and western parts of the Boreal Forest Region in Ontario (Fig. 10), it is evident that in mature and overmature jack pine cull increases from east to west in the Province. In instances where it was possible to compare trees on similar sites in these three areas, the same regional differences in cull factors were observed.

Site

The total sample of jack pine shown in Table 7 was analysed with respect to site conditions based on

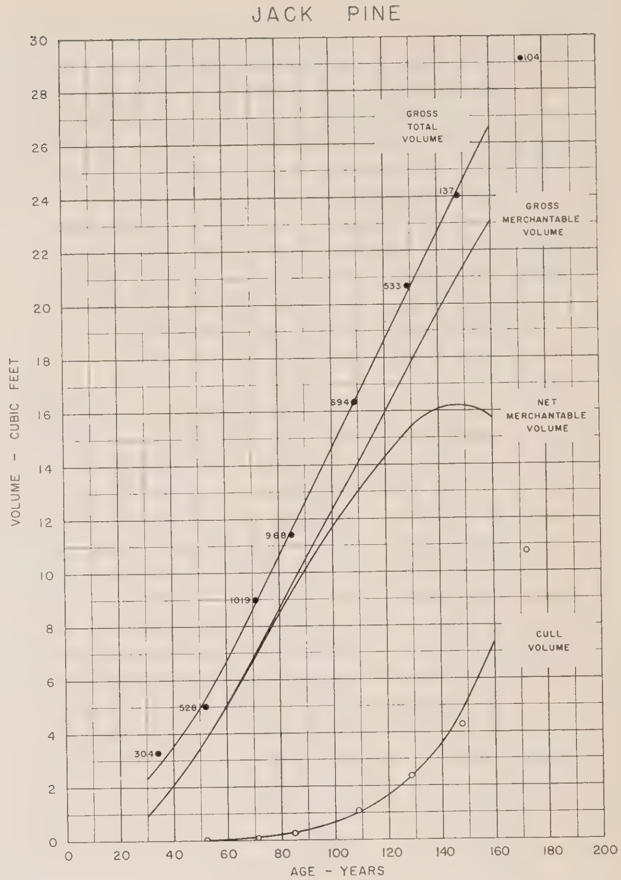


FIG. 8. — *Average volume per tree in relation to age. All sites combined — Boreal Forest Region.*

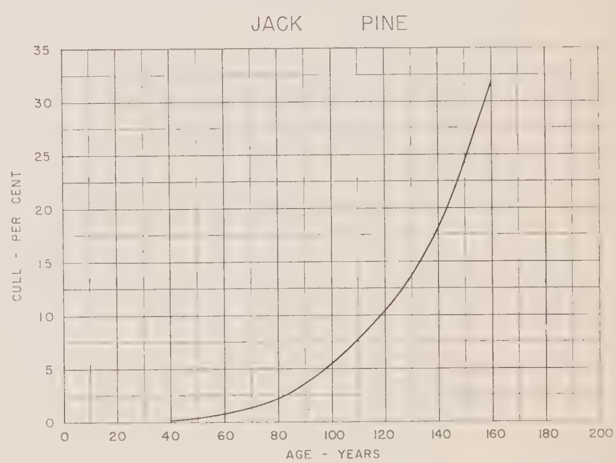


FIG. 9. — *Cull as a percentage of the gross merchantable volume in relation to age. Average of all sites — Boreal Forest Region.*

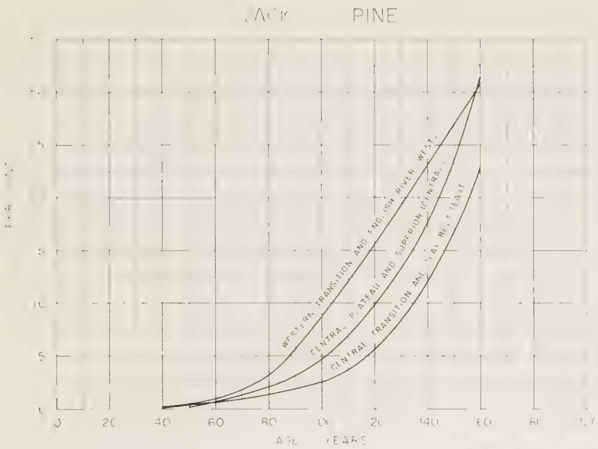


FIG. 10. — *Cull per cent in relation to age by groups of ecological sections. Boreal Forest Region.*

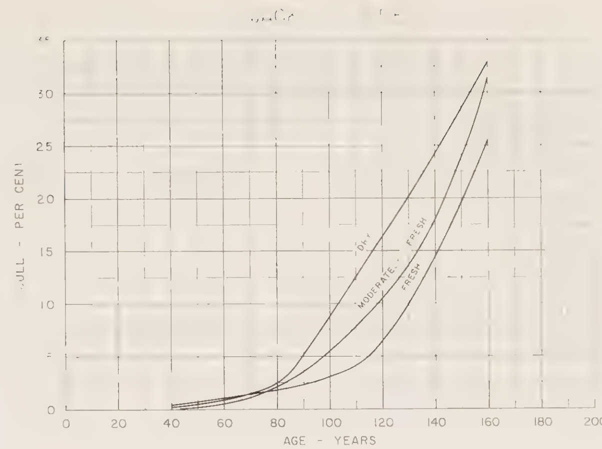


FIG. 11 — *Cull per cent in relation to age by soil moisture groups. Boreal Forest Region.*

available soil moisture. It was found that there was sufficient difference in the degree of cull in jack pine on soils classified as "0" and "1" moisture classes to require their separation in the analysis. Consequently, three groups of sites are considered in jack pine: dry ("0" moisture class), moderately fresh ("1" moisture class), and fresh (2–3 moisture class). Samples collected on moist sites (4–5 moisture class) were not sufficient to show the relationship of cull to age on these sites.

The relationship of cull to age on the three previously mentioned groups of sites is illustrated by separate curves, Fig. 11. Up to 80 years of age, there is practically no difference in cull for jack pine growing on different sites. More cull, however, may be expected in older jack pine growing on dry sites than in trees growing on moderately fresh and fresh sites. Trees growing on these latter sites attain larger size, both in diameter and height, and therefore net merchantable volume per tree is much greater on moderately fresh and fresh sites combined than on dry sites (Tables 10, 11, and Fig. 12).

With regard to other characteristics of site which may influence the degree of cull in jack pine, it is felt that such features as depth of soil, nutrient level, and stand history should be taken into consideration when a more detailed examination of cull is undertaken in a specific area. The available data indicate that a higher degree of cull may be expected in trees growing on shallow soils, as well as in jack pine stands which were subjected to fires, resulting in direct damage to residual trees.

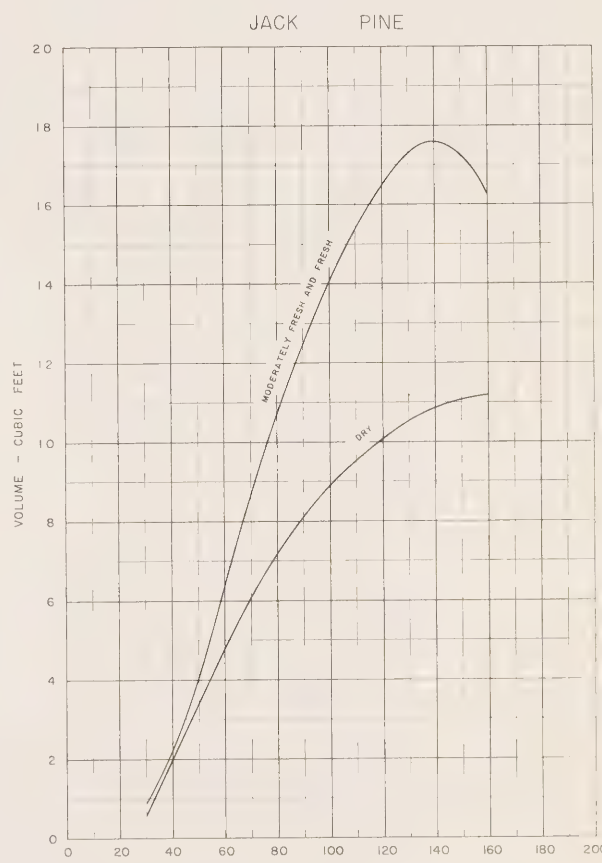


FIG. 12. — *Net merchantable volume per tree in relation to age for dry and combined moderately fresh and fresh sites. Boreal Forest Region.*

In addition to investigating the influence of site based on soil moisture groups, the degree of cull in jack pine stands was examined using the site classes based on average stand-height development which were introduced in the growth and yield studies (12).

It was found that the degree of cull was higher in the stands on medium-quality sites (Site-class 2) than in stands on better sites (Site-class 1). This observation is illustrated in Fig. 13, which shows percentage of cull in relation to age for these two sites. The sample of jack pine stands on poor sites (Site-class 3) was not sufficient to show a definite trend of cull. However, the few samples obtained indicate that a still higher degree of cull may be expected on these sites. It is pointed out that the better sites (Site-class 1) of the growth and yield classification correspond in general to the moderately fresh and fresh sites, and that the medium sites (Site-class 2) are largely comparable to the dry sites.

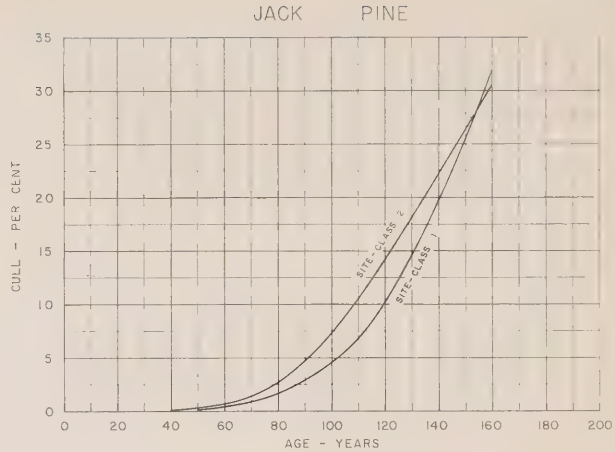


FIG. 13. — *Cull per cent in relation to age by sites classified according to stand height-age development. Boreal Forest Region.*

Rotation

The influence of cull on the rotation of jack pine was also investigated. It appears that the rotation of jack pine stands for pulpwood production, calculated on the basis of the growth and yield studies, occurs between 50 and 60 years for all the three site classes. Since the degree of cull in jack pine up to 60 years of age is only about one per cent, the influence of cull on rotation is negligible. However, if it is desired to increase the range of potential products in jack pine stands, it would be necessary to consider a rotation up to 100 years. In these circumstances, cull would likely be between 3 and 9 per cent, depending on the region of the province (Table 9).

Table 7—JACK PINE

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	304	34	41	5.3	990.02	401.79	588.23	0.17	588.06	40.6	......
41–60	528	52	52	5.8	2,645.08	857.91	1,787.17	11.50	1,775.67	32.4	0.6
61–80	1,019	71	61	7.5	9,152.05	1,851.66	7,300.39	104.62	7,195.77	20.2	1.4
81–100	968	85	63	8.1	11,034.91	1,962.86	9,072.05	247.04	8,825.01	17.8	2.7
101–120	694	109	69	9.4	11,331.23	1,699.32	9,631.91	758.29	8,873.62	15.0	7.9
121–140	533	129	73	10.5	11,021.53	1,539.70	9,481.83	1,256.34	8,225.49	14.0	13.2
141–160	137	148	75	11.3	3,291.66	453.80	2,837.86	589.45	2,248.41	13.8	20.8
161+	104	172	74	12.5	3,031.79	368.35	2,663.44	1,118.46	1,544.98	12.1	42.0
Total	4,287	......	....	......	52,498.27	9,135.39	43,362.88	4,085.87	39,277.01	......	......
Average	....	......	....	......	....	....	....	....	....	17.4	9.4

Table 8—JACK PINE

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

ALL SITES COMBINED— BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	39	4.2	2.34	1.40	0.94	..	0.94	59.8	...
40	45	5.2	3.54	1.46	2.08	.	2.08	41.2	0.1
50	51	6.0	4.97	1.50	3.47	0.01	3.46	30.2	0.3
60	56	6.7	6.74	1.65	5.09	0.04	5.05	24.5	0.8
70	59	7.4	8.63	1.81	6.82	0.09	6.73	21.0	1.3
80	63	7.9	10.61	1.95	8.66	0.19	8.47	18.4	2.2
90	65	8.4	12.62	2.12	10.50	0.39	10.11	16.8	3.7
100	67	9.0	14.67	2.34	12.33	0.68	11.65	16.0	5.5
110	69	9.5	16.58	2.52	14.06	1.09	12.97	15.2	7.8
120	71	10.0	18.65	2.68	15.97	1.66	14.31	14.4	10.4
130	73	10.5	20.71	2.84	17.87	2.44	15.43	13.7	13.7
140	74	11.0	22.71	3.05	19.66	3.54	16.12	13.4	18.0
150	75	11.4	24.69	3.27	21.42	5.24	16.18	13.2	24.5
160	76	11.9	26.59	3.51	23.08	7.34	15.74	13.2	31.8

Mature jack pine stand, Central Transition Ecological Section.

Table 9—JACK PINE

Cull as a Percentage of the Gross Merchantable Volume, by Age Classes and Ecological Sections

BOREAL FOREST REGION

Age Class, Years	Ecological Sections								
	Eastern			Central			Western		
	Central Transition	Clay Belt	Average	Superior	Central Plateau	Average	Western Transition	English River	Average
40	......	0.2	0.1	......	......	......	0.2	......	0.2
50	0.4	0.3	0.4	......	0.5	0.2	0.6	0.4	0.5
60	0.9	0.4	0.7	......	1.0	0.7	0.9	1.2	1.0
70	1.4	0.6	1.1	0.9	1.5	1.4	1.6	2.6	1.8
80	2.0	0.9	1.4	2.3	2.1	2.1	2.7	4.4	3.2
90	2.9	1.2	1.9	3.8	2.9	3.1	4.8	6.8	5.6
100	4.0	1.6	2.5	5.6	4.2	4.7	8.0	9.4	8.8
110	5.2	2.4	3.7	7.8	6.1	7.0	12.5	11.9	12.0
120	6.7	3.9	5.6	10.8	8.6	9.9	17.4	14.4	15.6
130	8.8	7.5	8.4	15.1	12.2	13.3	22.8	17.1	19.3
140	12.0	....	12.0	20.5	16.9	17.6	28.3	19.6	23.1
150	16.8	....	16.8	26.8	22.7	23.5	34.2	22.2	27.0
160	22.9	....	22.9	34.0	30.6	31.4	40.3	24.8	30.8

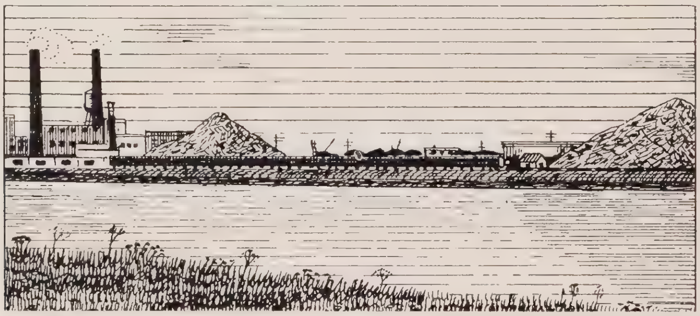


Table 10—JACK PINE

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

MODERATELY FRESH AND FRESH SITES — BOREAL FOREST REGION

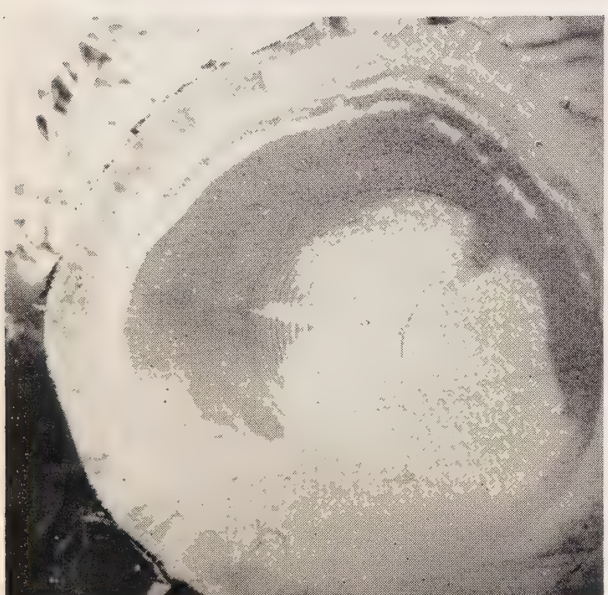
Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet					Percentage	
			Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	39	4.3	2.49	1.62	0.87	......	0.87	65.1	......
40	47	5.3	3.85	1.65	2.20	......	2.20	42.9	0.1
50	54	6.2	5.74	1.69	4.05	0.01	4.04	29.4	0.2
60	60	7.1	8.15	1.75	6.40	0.04	6.36	21.5	0.6
70	64	7.9	10.70	1.98	8.72	0.10	8.62	18.5	1.1
80	67	8.6	13.12	2.22	10.90	0.21	10.69	16.9	1.9
90	70	9.1	15.27	2.40	12.87	0.41	12.46	15.7	3.2
100	71	9.6	17.25	2.53	14.72	0.70	14.02	14.7	4.8
110	73	10.1	19.17	2.69	16.48	1.10	15.38	14.0	6.7
120	74	10.5	20.94	2.84	18.10	1.63	16.47	13.6	9.0
130	75	10.9	22.64	2.99	19.65	2.36	17.29	13.2	12.0
140	75	11.3	24.20	3.15	21.05	3.45	17.60	13.0	16.4
150	76	11.6	25.65	3.30	22.35	5.10	17.25	12.9	22.8
160	76	12.1	27.01	3.46	23.55	7.28	16.27	12.8	30.9

Table 11—JACK PINE

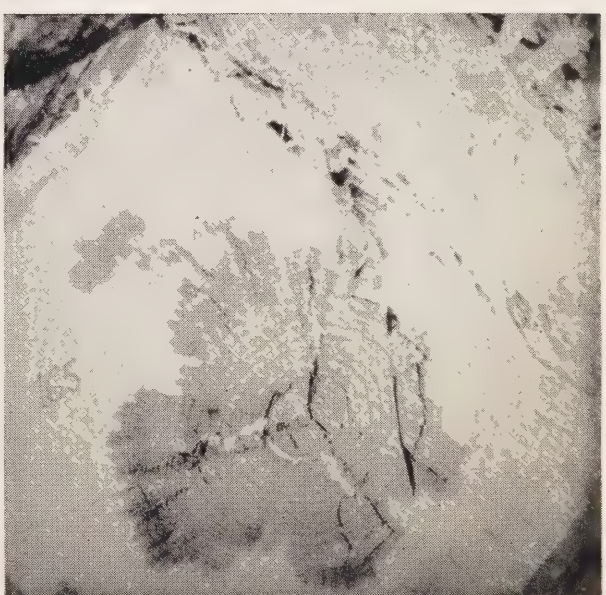
Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

DRY SITES — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	36	4.2	1.79	1.23	0.56	......	0.56	68.7	. ...
40	44	5.1	3.32	1.34	1.98	......	1.98	40.4	0.3
50	49	5.9	4.86	1.46	3.40	0.02	3.38	30.0	0.6
60	54	6.6	6.40	1.58	4.82	0.05	4.77	24.7	1.0
70	57	7.1	7.84	1.71	6.13	0.09	6.04	21.8	1.5
80	60	7.6	9.23	1.86	7.37	0.18	7.19	20.2	2.4
90	62	8.0	10.50	1.97	8.53	0.45	8.08	18.8	5.3
100	63	8.4	11.78	2.07	9.71	0.85	8.86	17.6	8.8
110	65	8.7	13.05	2.17	10.88	1.36	9.52	16.6	12.5
120	66	9.1	14.30	2.30	12.00	1.95	10.05	16.1	16.2
130	67	9.4	15.61	2.44	13.17	2.65	10.52	15.6	20.1
140	67	9.7	16.91	2.57	14.34	3.47	10.87	15.2	24.2
150	68	10.0	18.15	2.69	15.46	4.41	11.05	14.8	28.5
160	69	10.2	19.46	2.79	16.67	5.48	11.19	14.3	32.9



Transverse section of jack pine with red pocket heart rot.



Transverse section of jack pine with brown cubical butt rot.

Balsam Fir

Balsam fir can be found in varying proportions in nearly all cover types of the Boreal Forest Region in northern Ontario, where it appears in association with jack pine, white and black spruce, white birch, and aspen. Balsam fir is also found as a common admixture in the understory of tolerant hardwood and mixedwood stands in the Algonquin and Algoma Ecological Sections of the Great Lakes-St. Lawrence Forest Region. Data on balsam fir in this region will be found on page 64.

Its prolific reproducing ability and highly competitive characteristics very often result in balsam fir reproduction taking over considerable areas of northern Ontario from other conifers. These are significant changes which should not be overlooked in future management planning.

At present, however, balsam fir occurs as a lesser component in stands, usually in the understory, and pure merchantable stands of this species are rare in Ontario. This condition has been influenced to a large degree by severe outbreaks of the spruce budworm *Choristoneura fumiferana* (Clem.) which have extended over most of northern Ontario in recent years. Considerable mortality of balsam fir trees resulted from these outbreaks (16). Thus the sample of balsam fir, which was limited to trees encountered in stands of other species, may not represent conditions which would prevail had merchantable stands mainly of balsam fir been sampled.

Since it is utilized predominantly for pulpwood, balsam fir was scaled as such for the purpose of this survey. The total sample of balsam fir in northern Ontario consisted of 1,139 trees which were encountered largely in mixedwood stands.

Some preliminary information concerning the types of decay in balsam fir and the associated fungi are provided in Appendix B, where Table 51 gives the proportion of different types and stages of decay and where Table 52 shows the specific fungi identified with these types of decay.

Age

Table 12 shows the volumetric relationship of cull to age; these data, recalculated on the basis of the average tree for each age class, were used to construct the graphs in Figs. 14 and 15. For easy application in management work, the data derived from the curves in these figures are presented by 10-year age classes in Table 13. Table 13 and Fig. 15 show that

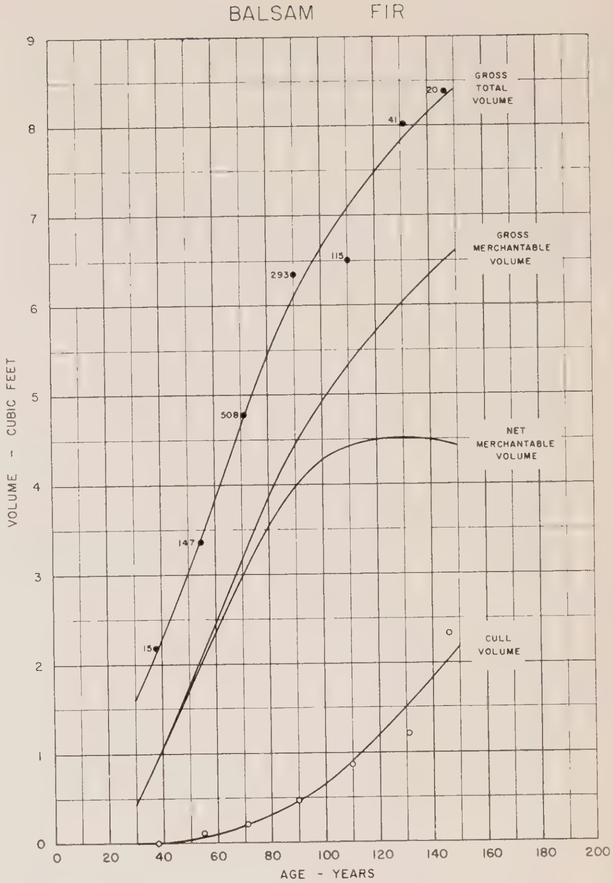


FIG. 14. — *Average volume per tree in relation to age. All sites combined — Boreal Forest Region.*

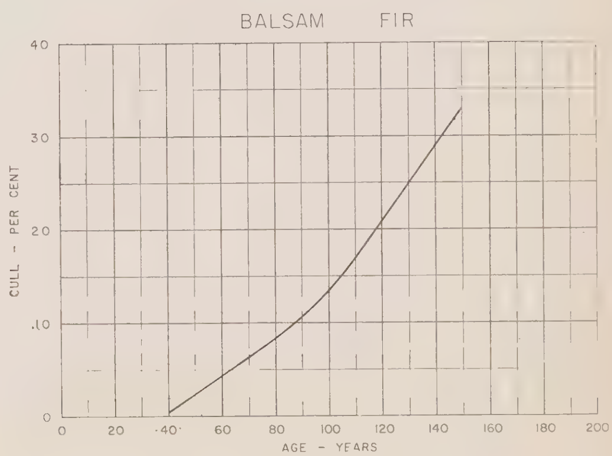


FIG. 15. — *Cull as a percentage of the gross merchantable volume in relation to age. Average of all sites — Boreal Forest Region.*

cull increases consistently with age, despite a rather poor distribution of sample trees.

Site

Although balsam fir grows on a wide range of sites, the rather limited number of samples necessitated combining the samples into three site groups, classified as dry, fresh, and moist, based on available soil moisture. Trees on wet sites comprised only about 6 per cent of the total sample, and were not included in the analysis of the influence of site on degree of cull.

Fig. 16 shows the relationship of cull to age within these three groups of sites. It appears that up to about 100 years of age, there is little difference in the degree of cull between dry and moist sites, and trees on both these sites have less cull than on fresh sites. However, where the fir is overmature, the differences in degree of cull on different sites become more apparent. In general, the relationship of cull to age on dry, fresh, and moist sites follows a similar pattern to that of black spruce, although the degree of cull is considerably higher for balsam fir.

No attempt was made in this survey to correlate the degree of cull to past attacks by the spruce budworm, but it is thought likely that a severe outbreak of the budworm may bring about an increased susceptibility of surviving balsam fir to wood-destroying fungi (15), which would eventually result in higher cull in the residual trees.

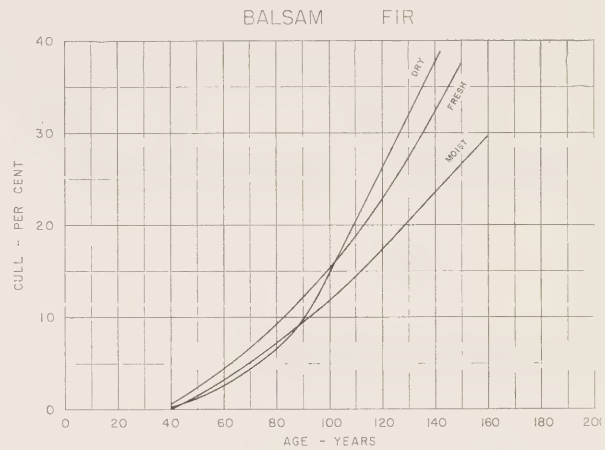


FIG. 16. — *Cull per cent in relation to age by soil moisture groups. Boreal Forest Region.*

Table 12—BALSAM FIR

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	15	38	34	4.9	32.66	15.79	16.87	....	16.87	48.3	......
41–60	147	55	39	5.5	493.97	196.76	297.21	16.80	280.41	39.8	5.7
61–80	508	71	44	6.2	2,428.19	765.12	1,663.07	107.40	1,555.67	31.5	6.5
81–100	293	90	48	7.1	1,858.83	490.33	1,368.50	136.77	1,231.73	26.4	10.0
101–120	115	110	49	7.2	748.03	210.04	537.99	99.82	438.17	28.1	18.6
121–140	41	131	49	7.8	328.62	82.64	245.98	49.41	196.57	25.1	20.1
141–160	20	146	54	8.4	167.88	35.48	132.40	46.51	85.89	21.1	35.1
161 +	....	......	....	....	....	....	....	....	....	......	......
Total	1,139	......	....	....	6,058.18	1,796.16	4,262.02	456.71	3,805.31		
Average	....	......	....	....	....	....	....	....	....	29.6	10.7

Table 13—BALSAM FIR

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	26	4.1	1.60	1.17	0.43	......	0.43	73.1	......
40	32	4.8	2.27	1.21	1.06	......	1.06	53.3	0.4
50	38	5.4	3.02	1.27	1.75	0.04	1.71	42.1	2.3
60	42	5.8	3.83	1.38	2.45	0.11	2.34	36.0	4.5
70	44	6.2	4.67	1.50	3.17	0.20	2.97	32.1	6.3
80	46	6.6	5.46	1.60	3.86	0.32	3.54	29.3	8.3
90	48	6.9	6.11	1.66	4.45	0.47	3.98	27.2	10.6
100	49	7.2	6.63	1.70	4.93	0.66	4.27	25.6	13.4
110	49	7.5	7.08	1.74	5.34	0.91	4.43	24.6	17.0
120	50	7.7	7.48	1.78	5.70	1.20	4.50	23.8	21.1
130	50	8.0	7.83	1.80	6.03	1.51	4.52	23.0	25.0
140	51	8.2	8.14	1.80	6.34	1.84	4.50	22.1	29.0
150	51	8.5	8.41	1.80	6.61	2.18	4.43	21.4	33.0

Transverse section of balsam fir with yellow stringy butt rot.

Transverse and longitudinal sections of balsam fir with red heart rot.

Trembling Aspen

Aspen occurs frequently throughout the whole of the Boreal Forest Region in northern Ontario. Associations of jack pine, white spruce, balsam fir, white birch, and aspen, as well as pure, or nearly pure, stands of aspen, are common in that area. Aspen also appears frequently in the Algonquin and Algoma Ecological Sections of the Great Lakes-St. Lawrence Forest Region, but is confined largely to dry sites in this area; data on aspen in this region will be found on page 63.

The commercial value of aspen has been growing in importance, and now there are a number of pulpwood mills which are using increasing volumes of aspen. There is also a small demand for aspen lumber and veneer, but this is confined to local areas. Since aspen is used mostly for pulpwood, it was scaled as such in this survey. The total sample of aspen in the Boreal Forest Region amounted to 2,343 trees.

The preliminary data with reference to the types of decay and stain, and to the associated specific fungi, are provided in Tables 53, 54, and 55 in Appendix B.

Age

Samples collected in different ecological sections were not large enough to allow a separate analysis of cull within each section. Consequently, all samples from the Boreal Forest Region were combined and summarized in Table 14, which shows the volumetric relationship of cull to age. This information, recalculated on the basis of the average tree for each age class, was used for the construction of the graphs in Figs. 17 and 18. Further, the curved values by 10-year age classes are provided for management use in Table 15. The trend of cull increasing with age is evident when Table 15 and Fig. 18 are examined.

Site

Three groups of sites based on soil moisture classes were examined for the influence of site on cull — namely, dry, fresh, and moist. The proportion of trees sampled on these site groups was 29, 56, and 15 per cent respectively. The preponderance of samples on fresh sites reflects the actual field conditions, since most aspen stands are growing on these sites.

Analysis showed that differences in the degree of cull between the site groups within each age class, although frequently fairly large, were erratic and

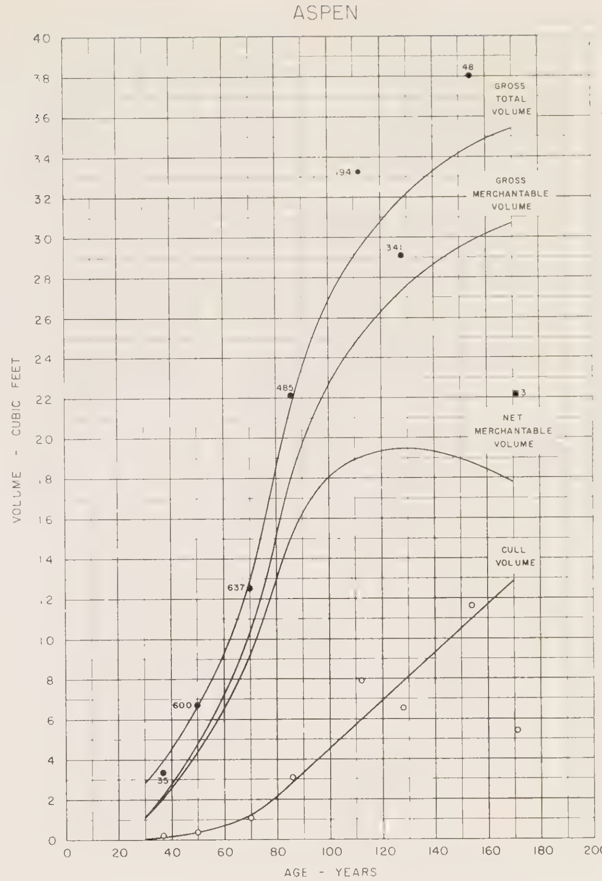


FIG. 17. — *Average volume per tree in relation to age. All sites combined — Boreal Forest Region.*

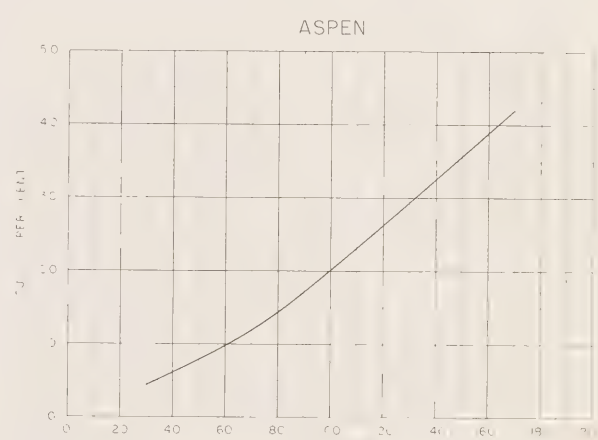


FIG. 18. — *Cull as a percentage of the gross merchantable volume in relation to age. Average of all sites — Boreal Forest Region.*

inconsistent. On the other hand, when average curves representing percentage of cull in relation to age for these site groups were compared, they were very close to each other. Furthermore, the over-all average percentage of cull for the dry, fresh, and moist sites was also fairly close. It was therefore apparent that the available sample did not provide conclusive evidence that the moisture factor has any important influence on the degree of cull in aspen. However, it is possible that other environmental factors — such as soil fertility, soil depth, and fires may influence the degree of cull in aspen to a larger extent than does soil moisture. It is also likely that outbreaks of the forest tent caterpillar, *Malacosoma disstria* (Hbn.), which periodically occur, increase the chance of infection by wood-destroying fungi. This would eventually lead to a higher degree of cull, thus affecting the evaluation of the influence of other site factors on cull in aspen.

The degree of cull in aspen stands was also examined with regard to sites classified on the basis of average stand-height development (12). For this comparison, only the 76 pure, or nearly pure, aspen stands in the sample were used. Here again the results were inconsistent, and there was little over-all difference in cull between the good, medium, and poor sites. However, where trends could be detected, there was an indication that the degree of cull was larger on poorer sites, but that the differences were of no practical consequence. Similar results were obtained by Basham in a study of decay of aspen in the Upper Pic River area of Ontario (1).

Rotation

The influence of cull on rotation of aspen was also examined. It appears that because of the short rotation of aspen cut for pulpwood, which is about 60 years for medium sites (Site-class 2), and because of the low degree of cull at that age (approximately 10 per cent), the effect of cull on rotation will be of small practical importance. However, if production of other forest products, such as saw-timber and veneer logs, is considered on the better sites, the rotation must be extended to obtain the required size of products. Under these circumstances, cull reaches higher proportions; the average degree of cull at 80 years will be approximately 14 per cent, and at 100 years approximately 20 per cent.

In the course of this survey, it has been observed that the degree of stocking of aspen stands decreases quite noticeably after the age of 100 years. Since this occurrence coincides with increasing cull, it is evident that the early removal of mature aspen stands would greatly reduce losses of considerable volume which result from cull and stand deterioration.

Table 14—ASPEN

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

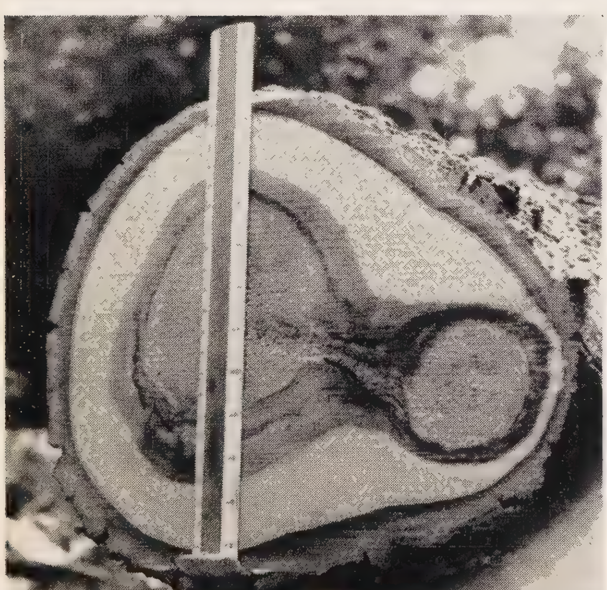
Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	35	37	49	5.2	124.40	48.19	76.21	7.76	68.45	38.7	10.2
41–60	600	50	60	6.3	4,038.83	1,148.85	2,889.98	226.63	2,663.35	28.4	7.8
61–80	637	70	69	8.2	7,992.17	1,441.73	6,550.44	703.84	5,846.60	18.0	10.7
81–100	485	86	78	10.3	10,735.53	1,884.45	8,851.08	1,505.93	7,345.15	17.6	17.0
101–120	194	112	86	12.5	6,455.41	952.86	5,502.55	1,536.97	3,965.58	14.8	27.9
121–140	341	128	81	12.1	9,926.11	1,430.19	8,495.92	2,238.50	6,257.42	14.4	26.3
141–160	48	154	84	14.0	1,825.08	249.08	1,576.00	558.78	1,017.22	13.6	35.5
161+	3	171	69	11.5	66.61	8.75	57.86	16.29	41.57	13.1	28.2
Total	2,343	......	....	......	41,164.14	7,164.10	34,000.04	6,794.70	27,205.34	......	......
Average	.	...	....	.. ..	....	....	.. ..	.. ..	....	17.4	20.0

Table 15—ASPEN

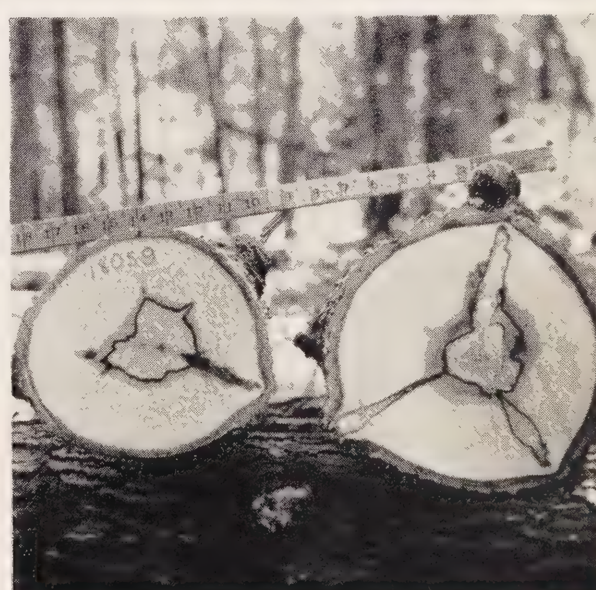
Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
30	40	4.1	2.85	1.70	1.15	0.05	1.10	59.6	4.3
40	50	5.3	4.55	1.75	2.80	0.17	2.63	38.5	6.1
50	58	6.4	6.65	1.86	4.79	0.38	4.41	28.0	7.9
60	66	7.4	9.22	2.01	7.21	0.71	6.50	21.8	9.8
70	71	8.4	12.95	2.48	10.47	1.25	9.22	19.2	11.9
80	76	9.4	18.40	3.20	15.20	2.17	13.03	17.4	14.3
90	79	10.2	23.43	3.82	19.61	3.36	16.25	16.3	17.1
100	80	11.0	26.80	4.20	22.60	4.55	18.05	15.7	20.1
110	82	11.6	29.03	4.41	24.62	5.71	18.91	15.2	23.2
120	82	12.2	30.77	4.52	26.25	6.89	19.36	14.7	26.2
130	83	12.6	32.18	4.60	27.58	8.11	19.47	14.3	29.4
140	83	13.0	33.25	4.65	28.60	9.29	19.31	14.0	32.5
150	83	13.4	34.15	4.70	29.45	10.53	18.92	13.8	35.8
160	83	13.7	34.85	4.72	30.13	11.70	18.43	13.5	38.8



Transverse section of aspen with yellow stringy trunk rot.



Transverse sections of aspen with white punky Fomes igniarius *decay.*

White Birch

White birch is commonly found in forest types of northern Ontario within the Boreal Forest Region. It occurs as a component species in most of the mixedwood stands, and as an admixture in the jack pine and upland spruce stands. Pure stands of white birch, and mixed stands of jack pine, spruce, aspen, and white birch are particularly common in the Central Transition, Central Plateau, Superior, and Western Transition Ecological Sections.

At the present stage of wood utilization in Ontario, there is very little demand for white birch, and therefore this species has a low commercial value. In pulpwood operations white birch is usually bypassed, and in the lumber industry there is only a limited, local demand for white birch sawlogs or short bolts. For the purpose of this survey, all sampled white birch trees were cut and scaled as 8-foot pulpwood.

The total sample of white birch amounted to 936 trees which were largely taken from mixedwood stands. Only a few plots were established in pure white birch stands.

The preliminary information dealing with the occurrence of the types of decay and stain, and of the associated specific fungi, is provided in Tables 56, 57, and 58 in Appendix B.

Age

The sample of white birch trees collected in different ecological sections was not large enough to allow a separate analysis of cull in each section. Therefore, all sampled trees were combined in one summary, Table 16, which was used as the basis for the graphic presentation of the volume relationship of an average tree to age (Fig. 19) and of the percentage of cull over age in relation to gross merchantable volume (Fig. 20). Data taken from these graphs are tabulated in Table 17 for convenient reference in management work.

Because of the small number of white birch trees over 130 years of age in the sample, the data in Table 17 may not be reliable for these older age classes. The steady increase of cull with age is evident when Fig. 20 and Table 17 are examined.

Site

Most of the sampled white birch trees were encountered on the dry and fresh sites, and comprised 35 per cent and 59 per cent respectively of the total gross merchantable volume. Therefore, only trees sampled on these two groups of sites based on soil moisture were considered in the analysis of the influence of site on the degree of cull (Fig. 21). It appears that there is no practical difference in the degree of cull in the trees sampled on the dry and fresh sites up to approximately 100 years of age. The difference becomes more apparent in the older age classes, where the degree of cull is noticeably higher on fresh sites. These sites, however, will likely produce a higher net merchantable volume, because the greater productive capacity of fresh sites will more than offset the somewhat higher degree of cull.

Rotation

It is thought that because of the small degree of cull which occurs in mature white birch, not exceeding 5 per cent up to 100 years of age, the influence of cull on rotation will be of little consequence.

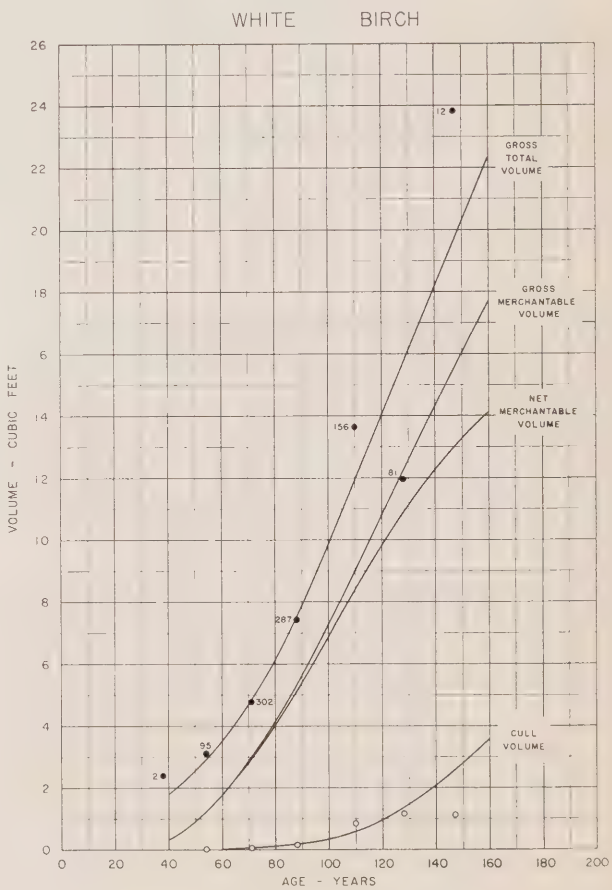


FIG. 19. — *Average volume per tree in relation to age. All sites combined — Boreal Forest Region.*

FIG. 20. — *Cull as a percentage of the gross merchantable volume in relation to age. Average of all sites — Boreal Forest Region.*

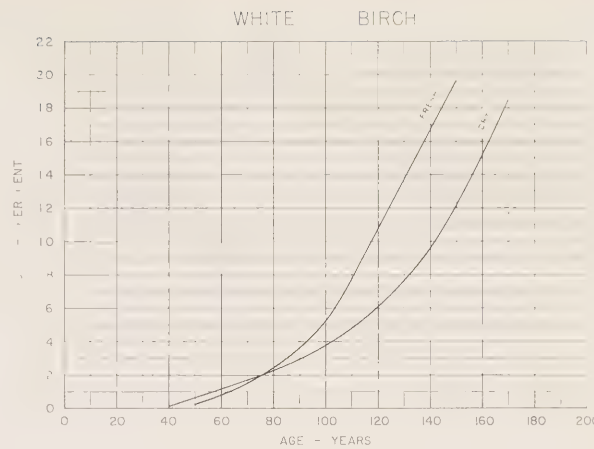


FIG. 21. — *Cull per cent in relation to age by soil moisture groups. Boreal Forest Region.*

Table 16—WHITE BIRCH

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	2	38	36	5.1	4.79	2.30	2.49	....	2.49	48.0	......
41–60	95	54	47	5.7	295.17	148.61	146.56	0.65	145.91	50.3	0.4
61–80	302	71	51	5.7	1,440.59	576.27	864.32	15.48	848.84	40.0	1.8
81–100	287	88	57	7.0	2,129.78	620.68	1,509.10	46.66	1,462.44	29.1	3.1
101–120	156	110	64	8.9	2,127.27	494.37	1,632.90	132.29	1,500.61	23.2	8.1
121–140	81	128	57	8.6	967.42	241.79	725.63	93.21	632.42	25.0	12.8
141–160	12	147	60	12.0	285.84	61.90	223.94	13.48	210.46	21.7	6.0
161+	1	170	65	15.0	34.50	9.76	24.74	4.34	20.40	28.3	17.5
Total	936	......	....	......	7,285.36	2,155.68	5,129.68	306.11	4,823.57	......	......
Average	......	......	....	......	....	....	....	....	....	29.6	6.0

Table 17—WHITE BIRCH

Average Volume per Tree in Cubic Feet, and Percentages of Tops, Stumps, and Cull by Age Classes; Curved Values

ALL SITES COMBINED — BOREAL FOREST REGION

Age Class, Years	Average Height, Feet	Average D.B.H., Inches	Volume per Tree in Cubic Feet					Percentage	
			Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
40	38	3.8	1.80	1.47	0.33	......	0.33	81.7	......
50	43	4.4	2.57	1.65	0.92	......	0.92	64.2	0.4
60	48	5.2	3.52	1.74	1.78	0.02	1.76	49.4	1.1
70	52	5.8	4.72	1.85	2.87	0.05	2.82	39.2	1.7
80	55	6.5	6.10	1.98	4.12	0.10	4.02	32.5	2.4
90	57	7.2	7.83	2.23	5.60	0.19	5.41	28.5	3.4
100	59	7.8	9.82	2.57	7.25	0.35	6.90	26.2	4.8
110	61	8.5	11.91	2.91	9.00	0.60	8.40	24.4	6.7
120	62	9.2	14.03	3.23	10.80	0.98	9.82	23.0	9.1
130	63	9.8	16.12	3.56	12.56	1.47	11.09	22.1	11.7
140	64	10.5	18.20	3.90	14.30	2.07	12.23	21.4	14.5
150	64	11.2	20.29	4.28	16.01	2.78	13.23	21.1	17.4
160	65	11.8	22.31	4.63	17.68	3.58	14.10	20.8	20.2

Transverse section of white birch with yellow stringy trunk rot.

THE GREAT LAKES - ST. LAWRENCE FOREST REGION

Forest Description

● The survey took place in two areas of this region, the Algoma and Algonquin Ecological Sections, for the purpose of examining cull primarily in the two main tolerant hardwood species, yellow birch and sugar maple. White pine, although characteristic of this region, has not been included in the survey.

The climatic conditions in this region are less severe than those in the Boreal Forest. Higher average temperatures, higher precipitation, and a longer growing season — 100 to 150 days — favour the wide variety of deciduous and coniferous species found in the forest cover of this region. In addition, many species which are characteristic of the Boreal Forest, such as black and white spruce, balsam fir, white birch, and aspen, are also encountered here in varying proportions.

Associations of sugar maple, yellow birch, and white pine are abundant in this region. Beech and hemlock constitute a common admixture in the sugar maple-yellow birch stands of the Algonquin Ecological Section, but their occurrence in the Algoma Section is somewhat limited. Other less frequently encountered deciduous species are: basswood, elm, ash, oak, black cherry, and ironwood.

The relief in both the Algoma and Algonquin Ecological Sections, showing a great range in elevation, has influenced to some degree the forest associations encountered in these areas. Higher elevations are generally occupied by tolerant hardwoods with some white pine and hemlock. Associations on lower elevations, on the other hand, usually have a higher coniferous content through an increase in white and red pine, spruce, and balsam fir (14).

Fires and logging are two of the primary aspects of stand history which may affect the degree of cull in tolerant hardwoods (2, 11). Although the areas under study in this survey had not been subjected to serious fires in recent times, it is possible that old fires, which may have occurred in these areas, and any repeated past logging operations, especially in the Algonquin Section, have had an effect on the amount of cull now found in the residual tolerant hardwood stands.

The tolerant hardwood species, mainly yellow birch and sugar maple, and to a much lesser extent basswood, beech, elm, ash, and black cherry, form the basis of a rather large hardwood lumber industry in the southern portion of Ontario. This, in turn, provides the material for furniture and other manufacturing plants on which whole communities are largely dependent.

Sugar Maple

Sugar maple is abundant in the Algonquin Ecological Section and in the southwestern part of the Algoma Section, where it occurs along the shores of Lake Superior and Lake Huron. Associations of sugar maple and yellow birch as leading species, with admixtures of white pine, white spruce, hemlock, and balsam fir in varying proportions, are common in these areas.

Because of the prolific reproducing ability and the highly competitive characteristics of sugar maple, there is a definite tendency for this species to take over large areas from other species, particularly yellow birch. This process is greatly accelerated by those cutting practices which utilize mostly yellow birch as the more valuable species, and which do not provide for birch regeneration. Thus large areas of overmature defective maple are left (10), and these present a formidable task in forest management.

Sugar maple is, at present, used mainly for sawlogs, with a limited proportion of the best logs used for veneer. There are abundant quantities of defective maple suitable for pulpwood, charcoal, and firewood, but demand for this marginal material is limited.

For the purpose of this project, maple was cut into log lengths classified as sawlogs or veneer logs and graded according to log quality. Where possible, tops and larger limbs were cut into 8-foot bolts and scaled as pulpwood.

The total sample of sugar maple consisted of 3,922 trees, which were encountered in mixed sugar maple-yellow birch stands of the Algoma and Algonquin Ecological Sections.

For percentage of cull and for gross total volume

there is practically no difference between the two ecological sections in trees up to 16 inches in diameter (Figs. 22 and 23). However, the more noticeable difference in cull and volume for trees in the higher diameter classes, as well as the fact that trees of the same diameter are older in the Algoma than in the Algonquin area (Fig. 24), warranted a separate presentation of the data for each section. Furthermore, although there is no practical difference in the height-diameter curves for maple in the two areas (Fig. 25), maple trees in the Algoma Section, particularly in the northern portion, were observed to have shorter clear boles. In addition, there was a higher proportion of better-quality logs in the Algonquin Section (Table 18).

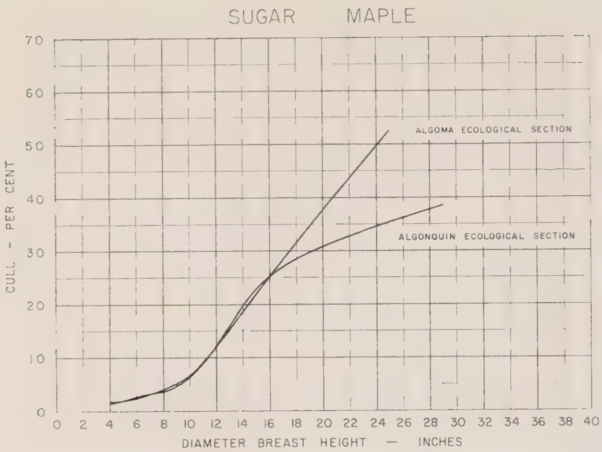


FIG. 22. — *Cull as a percentage of the gross merchantable volume in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

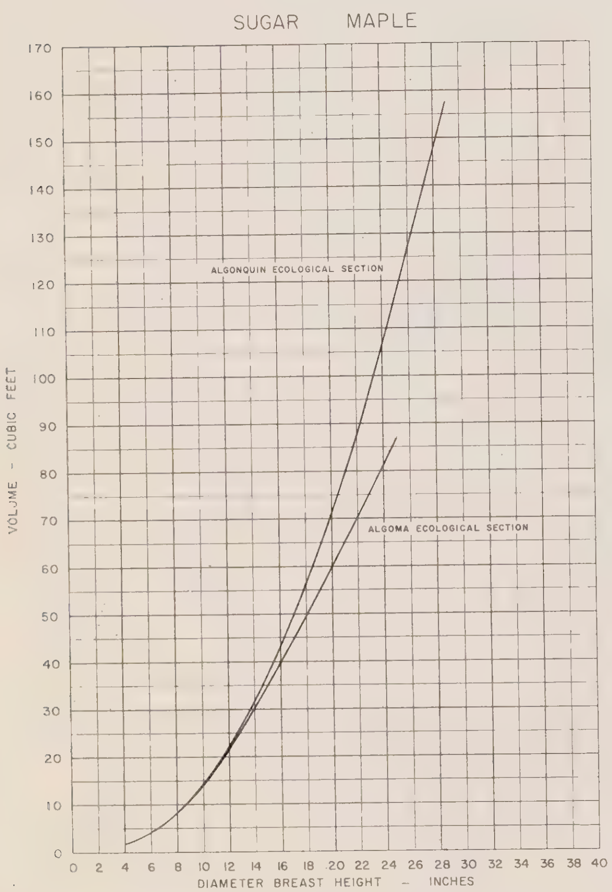


FIG. 23. — *Average gross total volume per tree in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

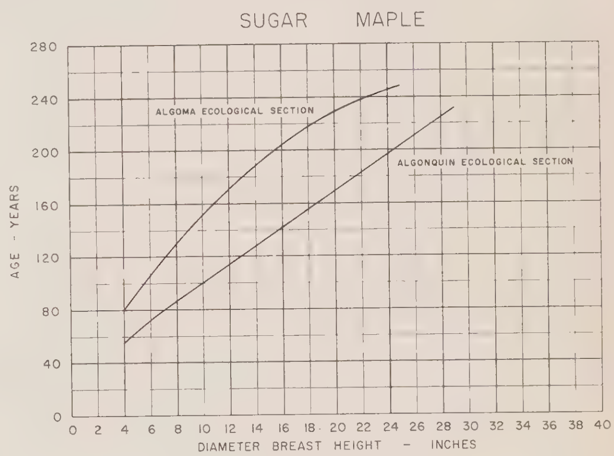


FIG. 24. — *Average age in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

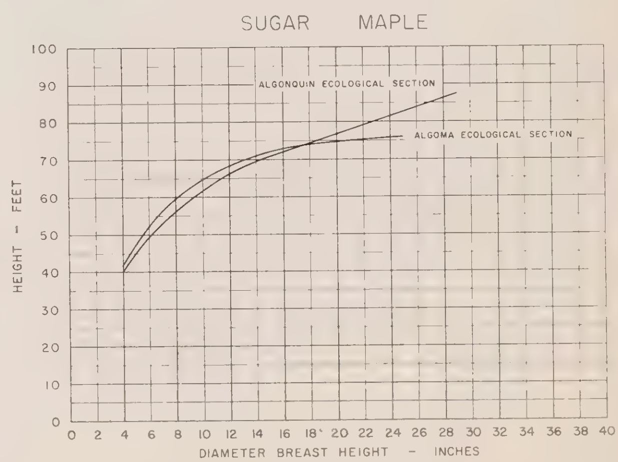


FIG. 25. — *Average height in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

Table 18—SUGAR MAPLE

Proportion of Log Grades in the Sample from the Algoma and Algonquin Ecological Sections Expressed as a Per Cent of the Gross Merchantable Volume

Ecological Section	Percentage of Gross Merchantable Volume				
	Grade 1 (Veneer) Logs	Grade 2 Logs	Grade 3 Logs	Cull Logs	Total
Algoma	5	29	46	20	100
Algonquin	7	49	28	16	100

Diameter Breast Height

As was pointed out previously, the ages of tolerant hardwoods are very difficult to determine in the field, and therefore the D.B.H. is usually used as a practical substitute for age classes in management work. Thus, cull, which was related to age for all boreal species, has been related to D.B.H. in the tolerant hardwood species.

Tables 19 and 20 give a volumetric summary of the field data, in cubic and board feet, by one-inch diameter classes for the Algoma and Algonquin Ecological Sections respectively. The cubic foot data were subsequently used in constructing the graphs in Figs. 22 and 26 for the Algoma Section, and in Figs. 22 and 27 for the Algonquin Section. The smoothed data for the average trees in the different diameter classes derived from these curves are shown in Tables 21 and 22 for management use in the respective areas. These tables also include the data derived from similar curves constructed for logs only in board foot measure, and the conversion factors from board feet to cubic feet found applicable during the survey.

The degree of cull in both of these areas shows a definite tendency to increase with size of trees, as expressed by D.B.H. classes. Because there is a close correlation between tree diameter and age, the degree of cull therefore increases with age.

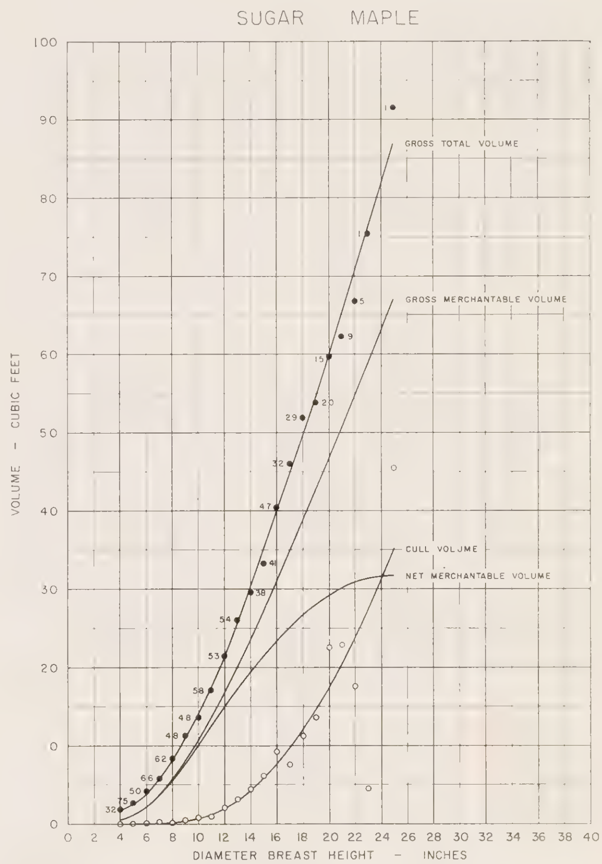


Fig. 26. — *Average volume per tree in relation to D.B.H. All sites combined — Algoma Ecological Section.*

Site

(1) *Algoma Ecological Section*

As was pointed out previously, there are two site factors, available soil moisture and landtype, taken into consideration in the analysis of the influence of site on the degree of cull in maple. In the Algoma Section, all sample plots were located on soils derived from the same granitic bedrock materials as those of the Sherborne landtype of the Algonquin Section. Therefore, all maple trees sampled in the Algoma Section were combined, for the analysis of cull, by sites based on soil moisture. Fig. 28 shows the relation of cull to D.B.H. for three groups of sites — dry, fresh, and moist. In general, there is little consistent difference in the degree of cull among these groups of sites, although cull appears to be somewhat lower on the moist sites. Height-diameter

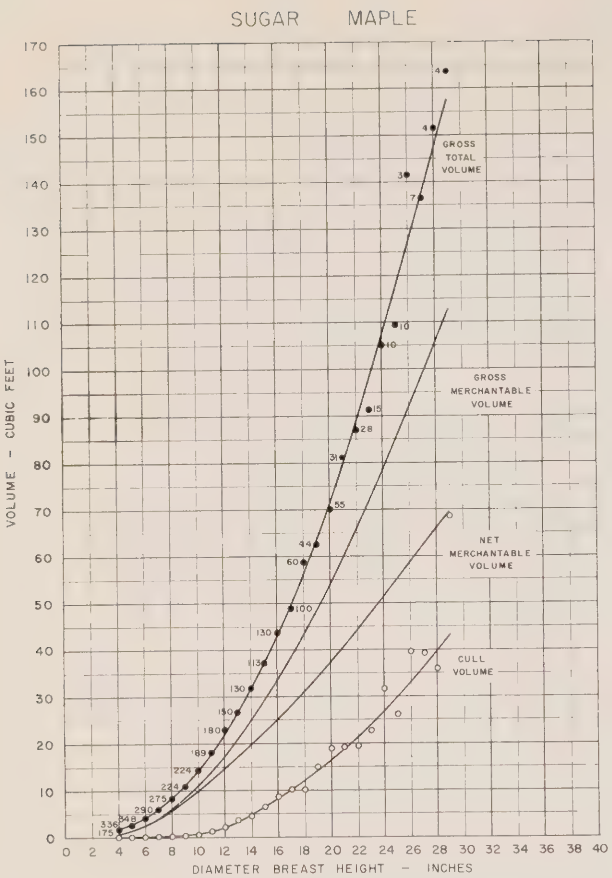


FIG. 27. — *Average volume per tree in relation to D.B.H. All sites combined — Algonquin Ecological Section.*

curves for the different sites in this section also indicate that maple growing on moist sites has a somewhat better development. However, since the data pertaining to moist sites represent only 7 per cent of the total sample of maple in Algoma, the foregoing relationships may not be reliable.

It must be pointed out that in the Algoma Ecological Section, where maple reaches the northern limit of its distribution in central Ontario, climate becomes an important factor in restricting the occurrence of maple to certain sites. Consequently, climate has an influence on the quality of maple. Along the northern edge of the section, maple is confined to the ridges which are dry, thus producing poor-quality maple. In the southern portion of the section, the climate is sufficiently favourable to allow maple to compete successfully with other species on the lower slopes and valleys. These sites are generally fresh and moist, thus producing better-quality maple.

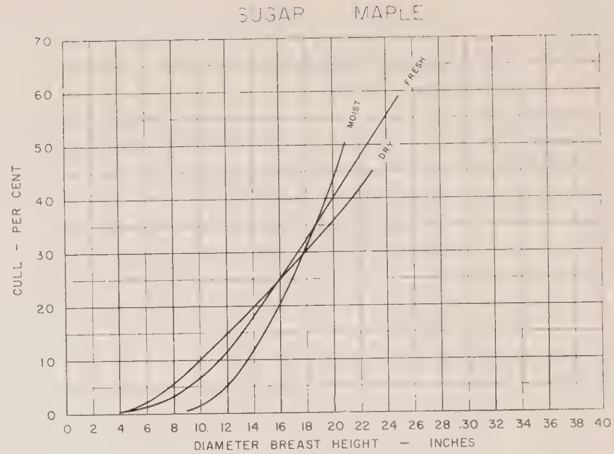


FIG. 28. — *Cull per cent in relation to D.B.H. by soil moisture groups. Algoma Ecological Section.*

(2) *Algonquin Ecological Section*

The majority (90 per cent) of maple trees in the Algonquin Section were encountered on the Sherborne landtype, which is predominant in this section. The sample of maple on the Limerick landtype, although amounting to only 10 per cent, was sufficient to compare trends in height development, average tree volume, and in the degree of cull in maple growing on these two landtypes. As may be observed in Figs. 29, 30, and 31, a better height growth and a correspondingly greater volume, particularly in higher diameter classes, and a somewhat smaller degree of cull may be expected in maple growing on the Limerick landtype which, in general, has richer soils. However, the differences were small and, therefore, of no practical importance at this level of investigation.

The analysis of the influence of site, based on soil moisture, on the degree of cull in maple within the two landtypes did not produce evidence that available soil moisture had an influence on the degree of cull. Marked variations of cull, on the other hand, were observed for some areas within similar physiographic sites and climatic conditions. It is possible that stand history may be responsible for these variations. Unlike the tolerant hardwood stands in the Algoma Section, which were mainly undisturbed, some of the areas in which maple was sampled in the Algonquin Section had been disturbed to varying degrees by past woods operations. Although maple was generally not utilized in these operations, the disturbances caused by logging could eventually lead to some increase in the degree of cull (2).

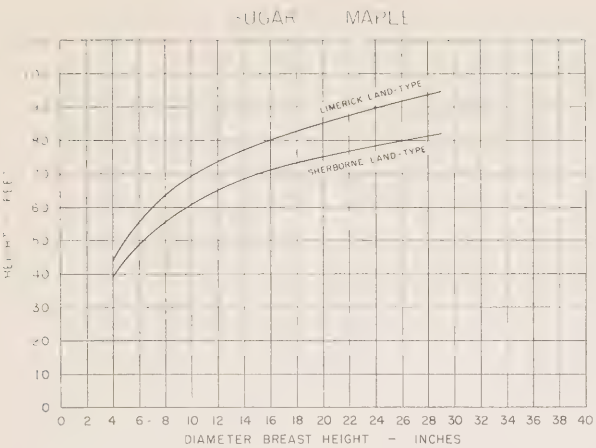


FIG. 29. — *Average height in relation to D.B.H. in the Limerick and Sherborne landtypes. Algonquin Ecological Section.*

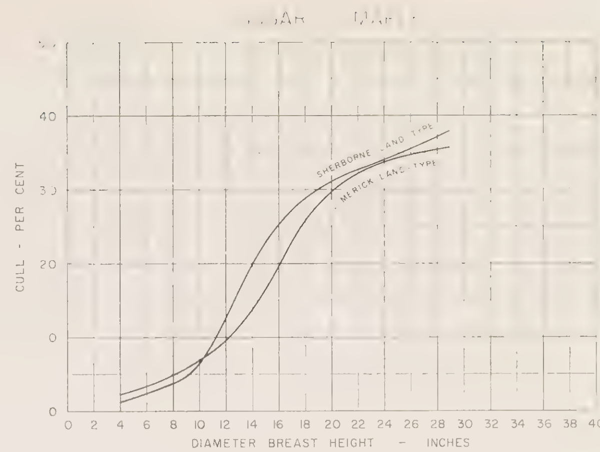


FIG. 31. — *Cull as a percentage of the gross merchantable volume in relation to D.B.H. in the Limerick and Sherborne landtypes. Algonquin Ecological Section.*

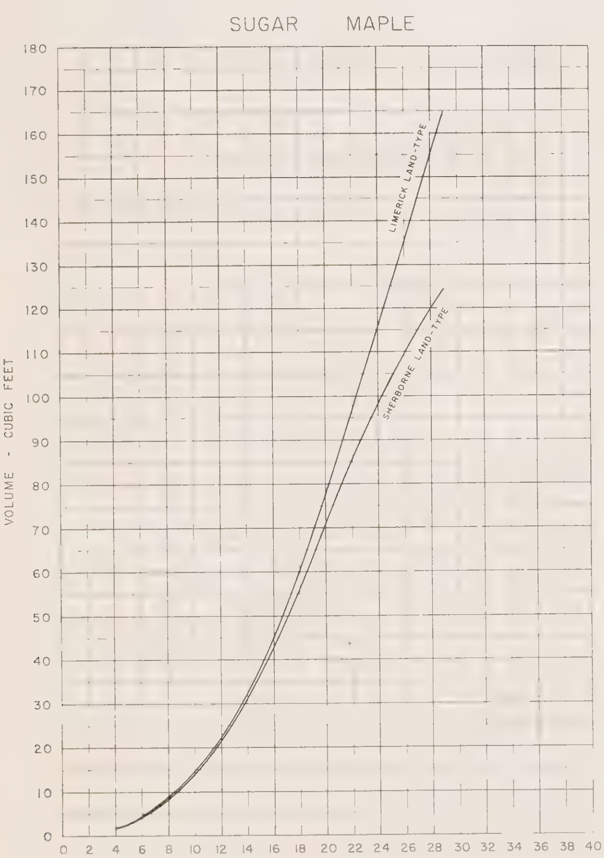
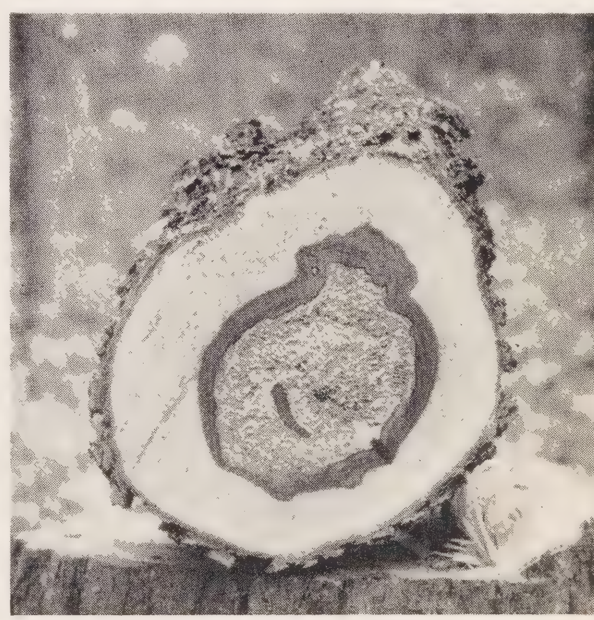


FIG. 30. — *Average gross total volume per tree in relation to D.B.H. in the Limerick and Sherborne landtypes. Algonquin Ecological Section.*



Transverse section of sugar maple with white punky Fomes igniarius *decay.*

Table 19—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merchantable: Logs	Pulp	Total	Cull: Logs	Pulp	Total	Net Merchantable: Logs	Pulp	Total
4	32	81	44	61.57	40.11	....	21.46	21.46	....	0.17	0.17	....	21.29	21.29
5	75	92	47	206.28	105.20	....	101.08	101.08	....	1.32	1.32	....	99.76	99.76
6	50	100	52	210.37	83.93	....	126.44	126.44	....	4.64	4.64	....	121.80	121.80
7	66	121	56	387.50	135.20	....	252.30	252.30	....	15.01	15.01	....	237.29	237.29
8	62	128	59	520.96	145.09	....	375.87	375.87	....	11.13	11.13	....	364.74	364.74
9	48	139	63	543.52	140.73	....	402.79	402.79	....	24.62	24.62	....	378.17	378.17
10	48	155	64	655.97	154.68	....	501.29	501.29	....	38.99	38.99	....	462.30	462.30
11	58	166	67	994.02	221.94	....	772.08	772.08	....	55.37	55.37	....	716.71	716.71
12	53	166	68	1,139.76	247.73	....	892.03	892.03	....	110.73	110.73	....	781.30	781.30
13	54	175	70	1,410.53	296.08	615.48	498.97	1,114.45	127.55	44.63	172.18	487.93	454.34	942.27
14	38	192	70	1,124.20	243.86	592.23	288.11	880.34	145.99	23.86	169.85	446.24	264.25	710.49
15	41	196	71	1,365.72	266.25	778.25	321.22	1,099.47	225.90	27.18	253.08	552.35	294.04	846.39
16	47	205	72	1,900.40	400.54	1,177.01	322.85	1,499.86	388.66	44.10	432.76	788.35	278.75	1,067.10
17	32	211	74	1,474.80	343.81	932.43	198.56	1,130.99	224.84	17.61	242.45	707.59	180.95	888.54
18	29	214	73	1,507.02	341.67	944.69	220.66	1,165.35	315.07	10.65	325.72	629.62	210.01	839.63
19	20	221	73	1,076.80	208.19	764.34	104.27	868.61	261.44	10.51	271.95	502.90	93.76	596.66
20	15	233	74	896.30	238.92	570.77	86.61	657.38	331.26	7.34	338.60	239.51	79.27	318.78
21	9	241	76	559.88	107.04	389.34	63.50	452.84	197.59	9.05	206.64	191.75	54.45	246.20
22	5	244	77	333.80	71.63	215.80	46.37	262.17	83.53	4.30	87.83	132.27	42.07	174.34
23	1	219	81	75.40	10.90	61.04	3.46	64.50	4.47	....	4.47	56.57	3.46	60.03
24	......	......	......	....	....	....	....	....	....	....	....	....	....	....
25	1	250	86	91.60	24.24	67.36	....	67.36	45.49	....	45.49	21.87	....	21.87
Total	784	......	......	16,536.40	3,827.74	7,108.74	5,599.92	12,708.66	2,351.79	461.21	2,813.00	4,756.95	5,138.71	9,895.66
Average	......	......	......	....	....	....	....	....	....	....	....	....	....	....

UGAR MAPLE

nd Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

LGOMA ECOLOGICAL SECTION

	PERCENTAGE			VOLUME IN BOARD FEET, ONTARIO RULE			PERCENTAGE	CONVERSION FACTORS FROM BOARD FEET TO CUBIC FEET, GROSS MERCH. VOL.	D.B.H., INCHES
TOPS AND STUMPS IN RELATION TO GROSS TOTAL VOL.	CULL IN RELATION TO GROSS MERCH. VOLUME			GROSS MERCH.	CULL	NET MERCH.	CULL IN REL. TO GROSS MERCH. VOL.		
	LOGS	PULP	AVERAGE	LOGS	LOGS	LOGS	LOGS	LOGS	
65.1	...	0.8	0.8	....	....	....	......	......	4
51.0	...	1.3	1.3	....	....	....	......	......	5
39.9	...	3.7	3.7	....	....	....	......	......	6
34.9	...	5.9	5.9	....	....	....	......	......	7
27.9	...	3.0	3.0	....	....	....	......	......	8
25.9	...	6.1	6.1	....	....	....	......	......	9
23.6	...	7.8	7.8	....	....	....	......	......	10
22.3	...	7.2	7.2	....	....	....	......	......	11
21.7	...	12.4	12.4	....	....	....	......	......	12
21.0	20.7	8.9	15.4	3,651	886	2,765	24.3	5.93	13
21.7	24.7	8.3	19.3	3,450	913	2,537	26.5	5.83	14
19.5	29.0	8.5	23.0	4,432	1,447	2,985	32.6	5.69	15
21.1	33.0	13.7	28.9	7,010	2,531	4,479	36.1	5.96	16
23.3	24.1	8.9	21.4	5,489	1,337	4,152	24.4	5.89	17
22.7	33.4	4.8	28.0	5,411	1,825	3,586	33.7	5.73	18
19.3	34.2	10.1	31.3	4,499	1,599	2,900	35.5	5.89	19
26.7	58.0	8.5	51.5	3,389	1,956	1,433	57.7	5.94	20
19.1	50.7	14.3	45.6	2,527	1,319	1,208	52.2	6.49	21
21.5	38.7	9.3	33.5	1,067	432	635	40.5	4.94	22
14.5	7.3	......	6.9	371	31	340	8.4	6.08	23
	......	......	......	....	....	....	......	......	24
26.5	67.5	......	67.5	415	261	154	62.9	6.16	25
	...	...	...	41,711	14,537	27,174	......	......	TOTAL
23.1	33.1	8.2	22.1	....	....	....	34.9	5.87	AVERAGE

Table 20–

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps

ALL SITES COMBINED–

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet										
				Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	175	51	41	304.08	246.03	...	58.05	58.05	...	0.62	0.62	...	57.43	57.43
5	336	66	44	915.54	453.69	...	461.85	461.85	...	8.39	8.39	...	453.46	453.46
6	348	71	50	1,453.90	554.36	...	899.54	,899.54	...	31.57	31.57	...	867.97	867.97
7	290	83	53	1,772.67	546.18	...	1,226.49	1 226.49	...	54.86	54.86	...	1,171.63	1,171.63
8	275	90	56	2,295.27	611.79	...	1,683.48	1'683.48	...	52.16	52.16	...	1,631.32	1,631.32
9	224	93	58	2,456.73	562.23	...	1,894.50	1,894.50	...	84.61	84.61	...	1,809.89	1,809.89
10	224	101	62	3,208.96	698.82	...	2,510.14	2,510.14	...	125.61	125.61	...	2,384.53	2,384.53
11	189	106	63	3,419.81	693.27	...	2,726.54	2,726.54	...	228.34	228.34	...	2,498.20	2,498.20
12	180	113	66	4,130.82	875.22	...	3,255.60	3,255.60	...	395.67	395.67	...	2,859.93	2,859.93
13	150	118	68	4,013.42	845.62	2,292.75	875.05	3,167.80	489.94	57.38	547.32	1,802.81	817.67	2,620.48
14	130	127	68	4,139.39	876.66	2,556.50	706.23	3,262.73	545.63	39.76	585.39	2,010.87	666.47	2,677.34
15	113	136	71	4,203.30	912.23	2,759.33	531.74	3,291.07	698.19	39.53	737.72	2,061.14	492.21	2,553.35
16	130	141	71	5,681.48	1,246.94	3,830.12	604.42	4,434.54	1,083.74	42.66	1,126.40	2,746.38	561.76	3,308.14
17	100	148	73	4,888.90	1,024.72	3,416.13	448.05	3,864.18	1,002.75	18.76	1,021.51	2,413.38	429.29	2,842.67
18	60	158	77	3,523.70	809.05	2,482.17	232.48	2,714.65	597.09	13.11	610.20	1,885.08	219.37	2,104.45
19	44	157	76	2,754.30	650.50	1,939.16	164.64	2,103.80	650.49	6.82	657.31	1,288.67	157.82	1,446.49
20	55	170	76	3,858.50	983.18	2,721.52	153.80	2,875.32	1,032.93	7.58	1,040.51	1,688.59	146.22	1,834.81
21	31	163	76	2,516.30	573.09	1,806.18	137.03	1,943.21	585.26	10.48	595.74	1,220.92	126.55	1,347.47
22	28	196	79	2,435.00	561.16	1,815.20	58.64	1,873.84	541.29	3.66	544.95	1,273.91	54.98	1,328.89
23	15	185	78	1,370.30	323.09	1,019.38	27.83	1,047.21	341.36	...	341.36	678.02	27.83	705.85
24	10	208	86	1,050.50	305.77	733.98	10.75	744.73	316.83	...	316.83	417.15	10.75	427.90
25	10	207	83	1,094.63	337.43	740.46	16.74	757.20	261.03	...	261.03	479.43	16.74	496.17
26	3	206	90	423.40	107.94	308.78	6.68	315.46	118.56	...	118.56	190.22	6.68	196.90
27	7	214	90	956.00	263.74	664.83	27.43	692.26	274.13	0.72	274.85	390.70	26.71	417.41
28	4	262	95	606.20	175.34	430.86	...	430.86	143.64	...	143.64	287.22	...	287.22
29	4	236	85	654.60	198.65	453.16	2.79	455.95	274.23	...	274.23	178.93	2.79	181.72
30	...	...	...	...	...	...	...	...	...	...	...	...	...	...
31	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	...	...	...	...	...	...	...	...	...	...	...	...	...	...
33	1	318	109	244.00	57.18	186.82	...	186.82	2.49	...	2.49	184.33	...	184.33
34	...	...	...	...	...	...	...	...	...	...	...	...	...	...
35	2	272	100	489.60	155.80	333.80	...	333.80	122.25	...	122.25	211.55	...	211.55
Total	3,138	...	...	64,861.30	15,649.68	30,491.13	18,720.49	49,211.62	9,081.83	1,222.29	10,304.12	21,409.30	17,498.20	38,907.50
Average	...	...	...	...	...	...	...	...	...	...	...	...	...	...

UGAR MAPLE

nd Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

LGONQUIN ECOLOGICAL SECTION

Percentage				Volume in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Tops and Stumps in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
80.9	......	1.1	1.1	....	....	....	......	......	4
49.6	......	1.8	1.8	....	....	....	......	......	5
38.1	......	3.5	3.5	....	....	....	......	......	6
30.8	......	4.5	4.5	....	....	....	......	......	7
26.7	......	3.1	3.1	....	....	....	......	......	8
22.9	......	4.5	4.5	....	....	....	......	......	9
21.8	......	5.0	5.0	....	....	....	......	......	10
20.3	......	8.4	8.4	....	....	....	......	......	11
21.2	......	12.2	12.2	....	....	....	......	......	12
21.1	21.4	6.6	17.3	12,875	3,213	9,662	25.0	5.62	13
21.2	21.3	5.6	17.9	14,347	3,578	10,769	24.9	5.61	14
21.7	25.3	7.4	22.4	16,044	4,631	11,413	28.9	5.81	15
21.9	28.3	7.1	25.4	22,556	7,293	15,263	32.3	5.89	16
21.0	29.4	4.2	26.4	20,049	6,669	13,380	33.3	5.87	17
23.0	24.1	5.6	22.5	14,741	4,131	10,610	28.0	5.94	18
23.6	33.5	4.1	31.2	11,645	4,501	7,144	38.7	6.01	19
25.5	38.0	4.9	36.2	16,563	7,172	9,391	43.3	6.09	20
22.8	32.4	7.6	30.7	10,947	3,976	6,971	36.3	6.06	21
23.0	29.8	6.2	29.1	11,166	3,752	7,414	33.6	6.15	22
23.6	33.5	......	32.6	6,055	2,118	3,937	35.0	5.94	23
29.1	43.2	......	42.5	4,449	1,865	2,584	41.9	6.06	24
30.8	35.3	......	34.5	4,610	1,652	2,958	35.8	6.23	25
25.5	38.4	......	37.6	1,863	790	1,073	42.4	6.03	26
27.6	41.2	2.6	39.7	4,243	1,743	2,500	41.1	6.38	27
28.9	33.3	......	33.3	2,716	987	1,729	36.3	6.30	28
30.3	60.5	......	60.1	2,886	1,831	1,055	63.4	6.37	29
	...	......	......	....	....	....	......	......	30
.	...	......	......	....	....	....	......	......	31
...	......	......	......	....	....	....	......	......	32
23.4	1.3	......	1.3	1,167	17	1,150	1.5	6.25	33
......	......	......	......	....	....	....	......	.....	34
31.8	36.6	......	36.6	2,124	893	1,231	42.0	6.36	35
......	......	......	......	181,046	60,812	120,234	......	......	Total
24.1	29.8	6.5	20.9	....	....	....	33.6	5.94	Average

Table 21—

Average Volume per Tree in Cubic Feet and Board Feet, Percentages of Tops, Stumps, and Cull

ALL SITES COMBINED–

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet										
				Gross Total	Top and Stump	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	32	80	41	1.79	1.24	....	0.55	0.55	....	0.01	0.01	....	0.54	0.54
5	75	93	47	2.44	1.37	....	1.07	1.07	....	0.02	0.02	....	1.05	1.05
6	50	106	52	3.82	1.67	....	2.15	2.15	....	0.05	0.05	....	2.10	2.10
7	66	118	56	5.82	2.04	....	3.78	3.78	....	0.12	0.12	....	3.66	3.66
8	62	130	60	8.33	2.41	....	5.92	5.92	....	0.23	0.23	....	5.69	5.69
9	48	140	62	11.09	2.84	....	8.25	8.25	....	0.41	0.41	....	7.84	7.84
10	48	151	65	14.19	3.33	....	10.86	10.86	....	0.71	0.71	....	10.15	10.15
11	58	161	67	17.82	3.91	....	13.91	13.91	....	1.26	1.26	....	12.65	12.65
12	53	170	68	21.53	4.56	....	16.97	16.97	....	2.05	2.05	....	14.92	14.92
13	54	179	70	25.68	5.42	12.11	8.15	20.26	2.24	0.84	3.08	9.87	7.31	17.18
14	38	188	71	30.30	6.40	16.00	7.90	23.90	3.64	0.78	4.42	12.36	7.12	19.48
15	41	196	72	35.02	7.41	19.97	7.64	27.61	5.32	0.73	6.05	14.65	6.91	21.56
16	47	204	73	39.78	8.52	23.87	7.39	31.26	7.19	0.68	7.87	16.68	6.71	23.39
17	32	211	73	44.75	9.70	27.90	7.15	35.05	9.30	0.64	9.94	18.60	6.51	25.11
18	29	217	74	49.73	10.88	31.95	6.90	38.85	11.63	0.59	12.22	20.32	6.31	26.63
19	20	224	74	54.78	12.04	36.09	6.65	42.74	14.24	0.54	14.78	21.85	6.11	27.96
20	15	229	75	59.96	13.27	40.29	6.40	46.69	17.04	0.49	17.53	23.25	5.91	29.16
21	9	234	75	65.27	14.53	44.59	6.15	50.74	20.18	0.44	20.62	24.41	5.71	30.12
22	5	238	75	70.65	15.83	48.90	5.92	54.82	23.52	0.40	23.92	25.38	5.52	30.90
23	1	242	76	76.00	17.29	53.04	5.67	58.71	27.01	0.36	27.37	26.03	5.31	31.34
24	....	246	76	81.53	18.70	57.43	5.40	62.83	30.89	0.32	31.21	26.54	5.08	31.62
25	1	248	76	87.00	20.02	61.79	5.19	66.98	34.96	0.28	35.24	26.83	4.91	31.74

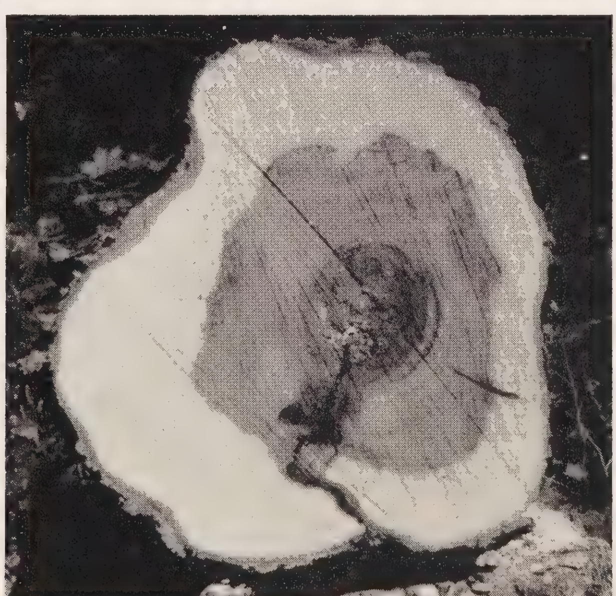
Transverse section of sugar maple with heart rot.

UGAR MAPLE

nd Conversion Factors from Board Feet to Cubic Feet, by Diameter Classes; Curved Values

LGOMA ECOLOGICAL SECTION

Percentage				Volume per Tree in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Top and Stump in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
69.3	......	1.8	1.8	......	......	......	......	......	4
56.1	......	1.9	1.9	......	......	......	......	......	5
43.7	......	2.3	2.3	......	......	......	......	......	6
35.1	......	3.2	3.2	......		......	......	......	7
28.9	......	3.9	3.9			......	......	......	8
25.6	......	5.0	5.0	......	......	......	......	......	9
23.5	......	6.5	6.5			......	......	......	10
21.9	......	9.1	9.1	......	......	......	......	......	11
21.2	......	12.1	12.1		......	......	......	......	12
21.1	18.5	10.3	15.2	71	16	55	22.5	5.86	13
21.1	22.8	9.9	18.5	94	24	70	25.5	5.87	14
21.2	26.6	9.6	21.9	117	34	83	29.1	5.86	15
21.4	30.1	9.2	25.2	140	45	95	32.1	5.87	16
21.7	33.3	9.0	28.4	164	57	107	34.8	5.88	17
21.9	36.4	8.6	31.5	187	70	117	37.4	5.85	18
22.0	39.5	8.1	34.6	212	85	127	40.1	5.87	19
22.1	42.3	7.7	37.5	236	102	134	43.2	5.86	20
22.3	45.3	7.2	40.6	262	120	142	45.8	5.88	21
22.4	48.1	6.8	43.6	287	140	147	48.8	5.87	22
22.7	50.9	6.3	46.6	311	160	151	51.4	5.86	23
22.9	53.8	5.9	49.7	337	183	154	54.3	5.87	24
23.0	56.6	5.4	52.6	363	207	156	57.0	5.87	25



Transverse section of sugar maple with yellow stringy butt rot.

Table 22–

Average Volume per Tree in Cubic Feet and Board Feet, Percentages of Tops, Stumps, and Cul

ALL SITES COMBINED -

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merchantable: Logs	Gross Merchantable: Pulp	Gross Merchantable: Total	Cull: Logs	Cull: Pulp	Cull: Total	Net Merchantable: Logs	Net Merchantable: Pulp	Net Merchantable: Total
4	175	55	40	1.77	1.02	....	0.75	0.75	....	0.01	0.01	....	0.74	0.74
5	336	64	45	2.85	1.35	....	1.50	1.50	....	0.03	0.03	....	1.47	1.47
6	348	73	49	4.38	1.68	....	2.70	2.70	....	0.07	0.07	....	2.63	2.63
7	290	80	53	6.08	1.94	....	4.14	4.14	....	0.13	0.13	....	4.01	4.01
8	275	86	56	8.49	2.29	....	6.20	6.20	....	0.22	0.22	....	5.98	5.98
9	224	93	59	11.38	2.73	....	8.65	8.65	....	0.40	0.40	....	8.25	8.25
10	224	100	62	14.32	3.12	....	11.20	11.20	....	0.69	0.69	....	10.51	10.51
11	189	107	64	17.78	3.72	....	14.06	14.06	....	1.23	1.23	....	12.83	12.83
12	180	114	66	21.95	4.55	....	17.40	17.40	....	2.06	2.06	....	15.34	15.34
13	150	121	68	26.73	5.53	15.47	5.73	21.20	2.91	0.39	3.30	12.56	5.34	17.90
14	130	128	69	31.84	6.66	19.80	5.38	25.18	4.58	0.34	4.92	15.22	5.04	20.26
15	113	135	71	37.46	7.98	24.44	5.04	29.48	6.38	0.31	6.69	18.06	4.73	22.79
16	130	142	72	43.16	9.37	29.12	4.67	33.79	8.18	0.28	8.46	20.94	4.39	25.33
17	100	148	73	49.34	10.91	34.13	4.30	38.43	10.04	0.24	10.28	24.09	4.06	28.15
18	60	155	74	56.30	12.73	39.59	3.98	43.57	12.08	0.21	12.29	27.51	3.77	31.28
19	44	162	75	63.40	14.70	45.07	3.63	48.70	14.25	0.19	14.44	30.82	3.44	34.26
20	55	169	77	71.27	16.99	50.98	3.30	54.28	16.56	0.17	16.73	34.42	3.13	37.55
21	31	176	78	79.41	19.39	57.05	2.97	60.02	18.90	0.15	19.05	38.15	2.82	40.97
22	28	183	79	88.21	22.12	63.44	2.65	66.09	21.45	0.13	21.58	41.99	2.52	44.51
23	15	190	80	97.55	25.25	69.97	2.33	72.30	24.20	0.11	24.31	45.77	2.22	47.99
24	10	197	82	107.21	28.45	76.72	2.04	78.76	27.04	0.08	27.12	49.68	1.96	51.64
25	10	204	83	116.94	31.60	83.61	1.73	85.34	29.99	0.06	30.05	53.62	1.67	55.29
26	3	211	84	127.17	35.21	90.49	1.47	91.96	33.10	0.05	33.15	57.39	1.42	58.81
27	7	217	85	137.30	38.45	97.64	1.21	98.85	36.45	0.04	36.49	61.19	1.17	62.36
28	4	224	86	147.50	41.71	104.81	0.98	105.79	39.80	0.03	39.83	65.01	0.95	65.96
29	4	231	88	157.70	44.89	112.05	0.76	112.81	43.35	0.02	43.37	68.70	0.74	69.44

UGAR MAPLE

nd Conversion Factors from Board Feet to Cubic Feet, by Diameter Classes; Curved Values

LGONQUIN ECOLOGICAL SECTION

Percentage				Volume per Tree in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Top and Stump in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
57.6	......	1.3	1.3	......	......	......	......	......	4
47.4	......	2.0	2.0	......	......	......	......	......	5
38.4	......	2.6	2.6	......	......	......	......	......	6
31.9	......	3.1	3.1	......	......	......	......	......	7
27.0	......	3.5	3.5	......	......	......	......	......	8
24.0	......	4.6	4.6	......	......	......	......	......	9
21.8	......	6.2	6.2	......	......	......	......	......	10
20.9	......	8.7	8.7	......	......	......	......	......	11
20.7	......	11.8	11.8	......	......	......	......	......	12
20.7	18.8	6.8	15.6	87	18	69	20.7	5.62	13
20.9	23.1	6.3	19.5	113	30	83	26.5	5.71	14
21.3	26.1	6.2	22.7	141	43	98	30.5	5.77	15
21.7	28.1	6.0	25.0	170	55	115	32.4	5.84	16
22.1	29.4	5.6	26.7	201	68	133	33.8	5.89	17
22.6	30.5	5.3	28.2	235	82	153	34.9	5.94	18
23.2	31.6	5.2	29.7	270	97	173	35.9	5.99	19
23.8	32.5	5.2	30.8	307	111	196	36.2	6.02	20
24.4	33.1	5.1	31.7	346	127	219	36.7	6.06	21
25.1	33.8	4.9	32.7	386	144	242	37.3	6.08	22
25.9	34.6	4.7	33.6	429	162	267	37.8	6.13	23
26.5	35.2	3.9	34.4	473	181	292	38.3	6.17	24
27.0	35.9	3.5	35.2	518	201	317	38.8	6.20	25
27.7	36.6	3.4	36.0	564	222	342	39.4	6.23	26
28.0	37.3	3.3	36.9	612	244	368	39.9	6.27	27
28.3	38.0	3.1	37.7	660	266	394	40.3	6.30	28
28.5	38.7	2.6	38.4	711	291	420	40.9	6.35	29

Yellow Birch

Yellow birch is one of the important species of both the Algoma and Algonquin Ecological Sections. With white pine, this species forms the major part of the timber cut and provides excellent material for veneer and sawlog operations. The preference for yellow birch as a commercially valuable species in woods operations and the strong competition from sugar maple regeneration have resulted in gradually diminishing proportions of yellow birch in tolerant hardwood stands. This situation is now being corrected in Ontario by the recent introduction of cutting methods to stimulate yellow birch regeneration, and by progressively increasing the utilization of sugar maple.

In this survey, yellow birch was cut and scaled as veneer and sawlogs according to log quality, and, where possible, tops and larger limbs were cut into 8-foot bolts and scaled as pulpwood.

The total sample of yellow birch amounted to 1,418 trees, which were encountered in sugar maple-yellow birch stands of both ecological sections.

The comparison of the survey data obtained in these two sections has shown that, although there is no difference in the height-diameter curves (Fig. 32), there is in the Algoma Section a smaller average volume for trees of the same diameter, and a higher percentage of cull than in the Algonquin Section (Figs. 33 and 34). Furthermore, the proportion of better-quality logs is higher in the Algonquin Section (Table 23).

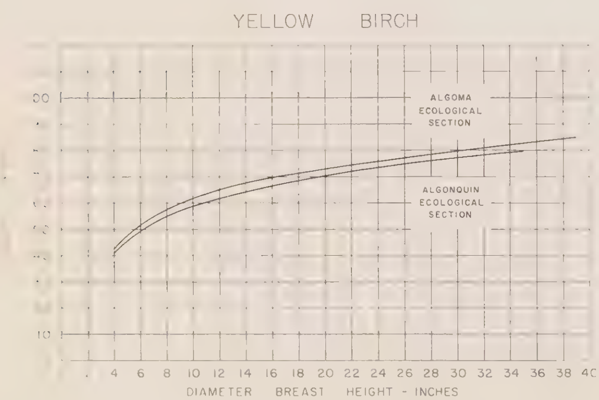


FIG. 32. — *Average height in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

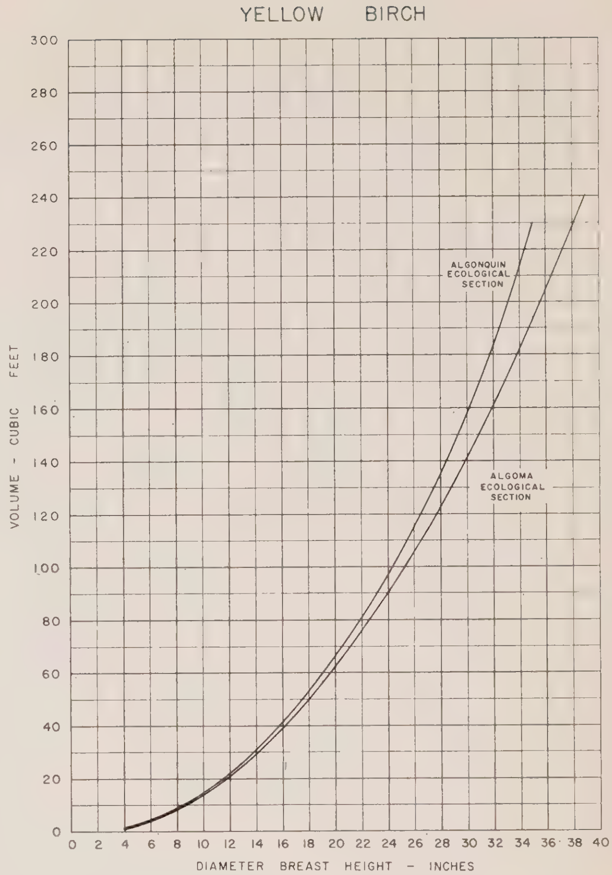


FIG. 33. — *Average gross total volume per tree in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

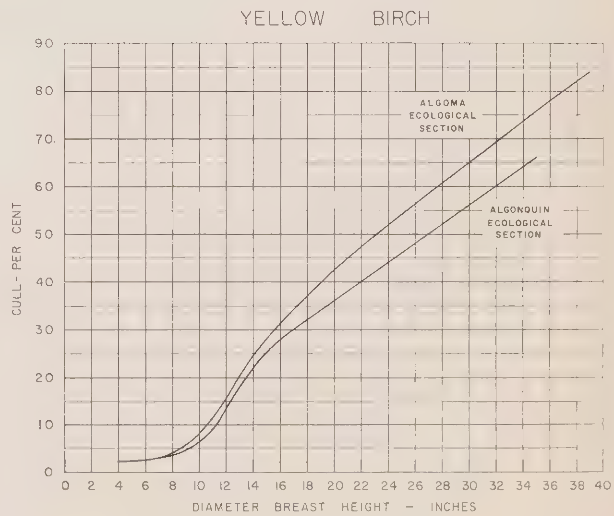


FIG. 34. — *Cull as a percentage of the gross merchantable volume in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

Table 23—YELLOW BIRCH

Proportion of Log Grades in the Sample from the Algoma and Algonquin Ecological Sections Expressed as a Per Cent of the Gross Merchantable Volume

Ecological Section	Percentage of Gross Merchantable Volume				
	Grade 1 (Veneer) Logs	Grade 2 Logs	Grade 3 Logs	Cull Logs	Total
Algoma	11	21	27	41	100
Algonquin	13	39	21	27	100

In all probability, climatic conditions in Algoma are not so favourable for yellow birch as in the Algonquin Section, because trees of the same diameter are as much as 30 to 40 years older in Algoma (Fig. 35), indicating slower growth. This fact could be partly responsible for the higher degree of cull in this section. For the foregoing reasons, the data for each ecological section were analysed separately.

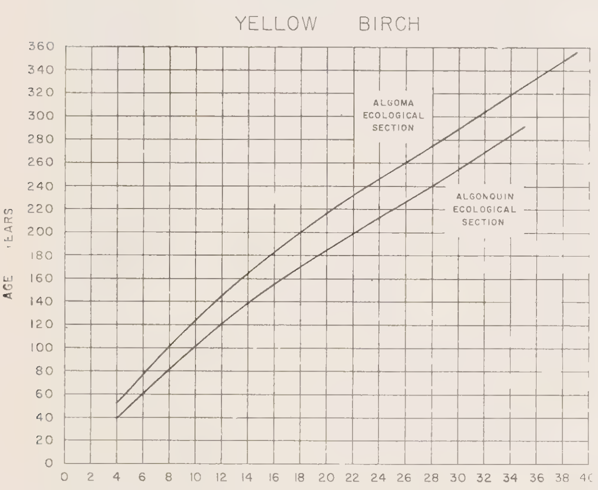


Fig. 35. — *Average age in relation to D.B.H. in the Algoma and Algonquin Ecological Sections.*

Diameter Breast Height

The volumetric summary of the field data, in cubic and board feet, by diameter classes is shown in Tables 24 and 25 for the Algoma and Algonquin Ecological Sections respectively. The cubic foot data were used to construct the graphs in Figs. 34 and 36 for the Algoma Section, and in Figs. 34 and 37 for the Algonquin Section. The smoothed data for an average tree in each D.B.H. class, derived from these curves, are shown in Tables 26 and 27 for management use in the Algoma and Algonquin Sections respectively. Similar curves were also constructed for the board foot measure, and the data derived, together with conversion factors from board feet to cubic feet, are included in Tables 26 and 27.

It is evident that the degree of cull in yellow birch increases fairly consistently with tree size, as expressed by D.B.H. classes, and since there is a strong correlation between diameter and age, it is obvious that the degree of cull also increases with age.

Site

A division of the Algonquin data into the Sherborne and Limerick landtypes investigated in sugar maple was not possible, because very few yellow birch trees were encountered on Limerick soils.

Further analysis of the influence of site, based on soil moisture classes, on the degree of cull in yellow birch was made separately for the Algoma and Algonquin Ecological Sections on the basis of dry, fresh, and moist groups of sites. For neither area was there any apparent correlation between cull percentage and soil moisture.

Some areas in which birch was sampled, particularly in the Algonquin Ecological Section, had been disturbed in the past to varying degrees by woods operations in which only the more valuable species and better-quality trees were utilized. This would undoubtedly result in a higher degree of cull in these stands, because sound yellow birch trees were removed, and the incidence of decay would be higher as a result of logging damage. Consequently, any evaluation of the relationship of cull to diameter and site in these disturbed stands may be obscured by their past history. It is possible that the influence of the stand history could outweigh other site factors when the degree of cull in the disturbed stands is considered (18).

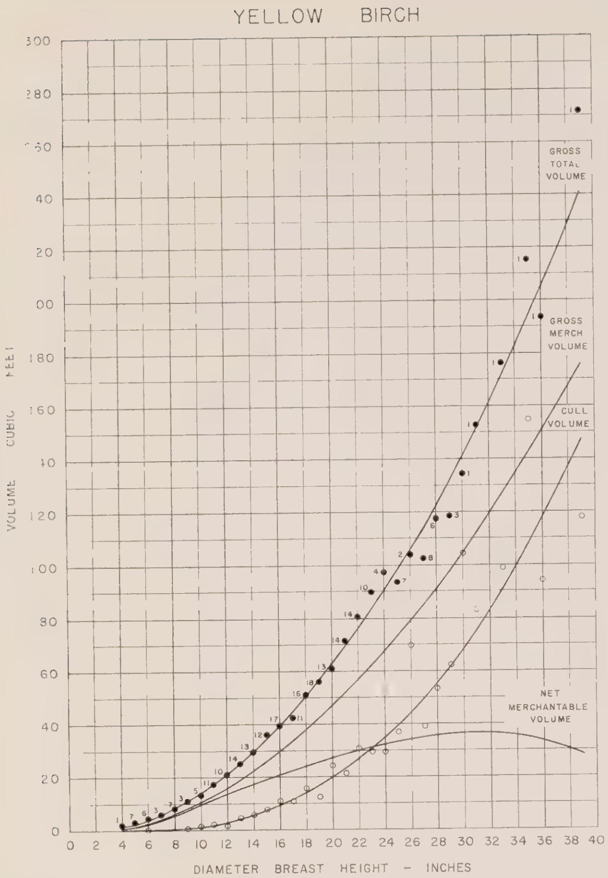


FIG. 36. — *Average volume per tree in relation to D.B.H. All sites combined — Algoma Ecological Section.*

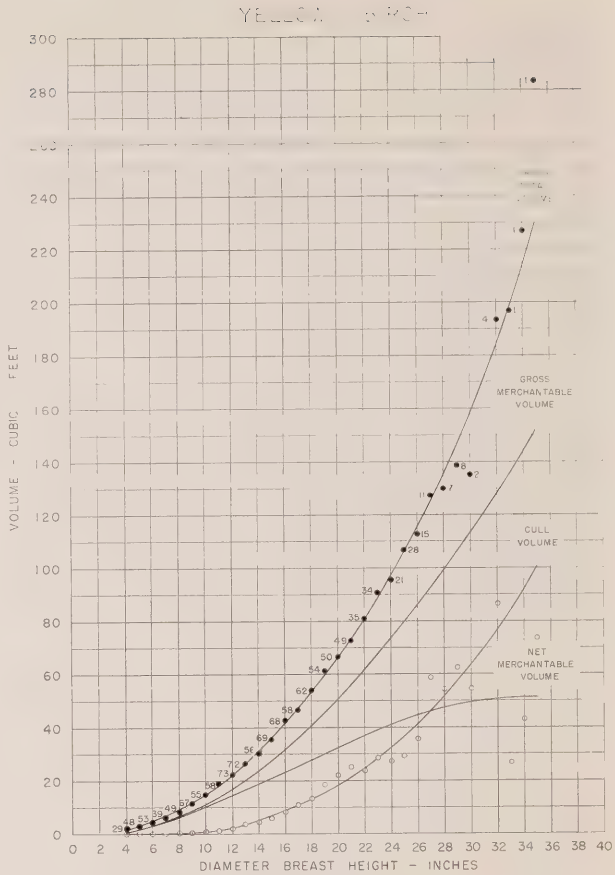


FIG. 37. — *Average volume per tree in relation to D.B.H. All sites combined — Algonquin Ecological Section.*

Transverse section of yellow birch with yellow stringy butt rot.

Transverse section of yellow birch with white punky trunk rot.

Felling yellow birch tree, Algoma Ecological Section.

Table 24—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps,

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	1	69	39	1.86	1.16	....	0.70	0.70	....	....	....	....	0.70	0.70
5	7	81	48	22.07	9.96	....	12.11	12.11	....	....	....	....	12.11	12.11
6	6	95	52	27.06	10.53	....	16.53	16.53	....	1.31	1.31	....	15.22	15.22
7	3	74	52	18.08	7.20	....	10.88	10.88	....	....	....	....	10.88	10.88
8	7	94	58	57.45	16.60	....	40.85	40.85	....	....	....	....	40.85	40.85
9	3	134	59	32.99	11.92	....	21.07	21.07	....	1.61	1.61	....	19.46	19.46
10	5	129	63	66.97	18.72	....	48.25	48.25	....	6.41	6.41	....	41.84	41.84
11	11	123	63	190.17	39.98	....	150.19	150.19	....	24.22	24.22	....	125.97	125.97
12	10	132	66	203.24	47.32	....	155.92	155.92	....	16.72	16.72	....	139.20	139.20
13	14	158	66	352.10	84.60	165.86	101.64	267.50	48.58	16.34	64.92	117.28	85.30	202.58
14	13	160	68	382.10	87.43	218.79	75.88	294.67	64.78	11.59	76.37	154.01	64.29	218.30
15	12	151	72	434.80	98.28	261.09	75.43	336.52	86.99	7.74	94.73	174.10	67.69	241.79
16	17	184	69	672.64	173.89	377.13	121.62	498.75	170.97	12.50	183.47	206.16	109.12	315.28
17	11	186	67	464.80	118.52	283.34	62.94	346.28	109.60	8.55	118.15	173.74	54.39	228.13
18	16	209	72	818.54	219.21	502.81	96.52	599.33	234.63	16.43	251.06	268.18	80.09	348.27
19	18	202	73	1,007.70	235.86	653.38	118.46	771.84	208.07	14.13	222.20	445.31	104.33	549.64
20	13	243	71	794.10	197.15	520.76	76.19	596.95	298.89	16.12	315.01	221.87	60.07	281.94
21	14	216	73	1,002.50	240.72	694.79	66.99	761.78	295.44	1.40	296.84	399.35	65.59	464.94
22	14	243	75	1,126.66	283.30	786.48	56.88	843.36	424.33	5.10	429.43	362.15	51.78	413.93
23	10	234	77	897.70	237.91	623.49	36.30	659.79	291.38	5.00	296.38	332.11	31.30	363.41
24	4	230	79	388.60	93.75	249.91	44.94	294.85	116.08	1.70	117.78	133.83	43.24	177.07
25	7	244	74	655.50	235.49	386.95	33.06	420.01	257.60	1.80	259.40	129.35	31.26	160.61
26	2	325	75	207.80	46.49	161.31	....	161.31	139.50	....	139.50	21.81	....	21.81
27	8	264	77	820.60	172.65	605.84	42.11	647.95	303.60	8.34	311.94	302.24	33.77	336.01
28	6	276	76	704.56	176.24	471.49	56.83	528.32	304.68	16.14	320.82	166.81	40.69	207.50
29	3	243	76	355.48	88.24	248.05	19.19	267.24	183.42	3.48	186.90	64.63	15.71	80.34
30	1	300	86	134.20	20.15	98.65	15.40	114.05	98.65	5.84	104.49	....	9.56	9.56
31	1	310	84	152.80	35.26	117.54	....	117.54	83.12	....	83.12	34.42	....	34.42
32														
33	1	380	67	176.30	77.47	98.83	....	98.83	98.83	....	98.83	....	....	....
34														
35	1	350	86	215.20	37.07	170.25	7.88	178.13	151.91	3.90	155.81	18.34	3.98	22.32
36	1	290	82	193.54	53.22	121.13	19.19	140.32	93.56	0.45	94.01	27.57	18.74	46.31
37														
38														
39	1	300	95	271.80	47.06	220.80	3.94	224.74	115.97	1.80	117.77	104.83	2.14	106.97
Total	241	......	....	12,849.91	3,223.35	8,038.67	1,587.89	9,626.56	4,180.58	208.62	4,389.20	3,858.09	1,379.27	5,237.36
Average														

ELLOW BIRCH

nd Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

LGOMA ECOLOGICAL SECTION

Percentage				Volume in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Tops and Stumps in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
62.4	......	......	......	....	....	....	......	......	4
45.1	......	......	......	....	....	....	......	......	5
38.9	......	7.9	7.9	....	....	....	......	......	6
39.8	......	......	......	....	....	....	......	......	7
28.9	......	......	......	....	....	....	......	......	8
36.1	......	7.6	7.6	....	....	....	......	......	9
28.0	......	13.3	13.3	....	....	....	......	......	10
21.0	......	16.1	16.1	....	....	....	......	......	11
23.3	......	10.7	10.7	....	....	....	......	......	12
24.0	29.3	16.1	24.3	905	328	577	36.2	5.46	13
22.9	29.6	15.3	25.9	1,224	379	845	31.0	5.59	14
22.6	33.3	10.3	28.1	1,445	532	913	36.8	5.53	15
25.9	45.3	10.3	36.8	2,183	1,076	1,107	49.3	5.79	16
25.5	38.7	13.6	34.1	1,624	725	899	44.6	5.73	17
26.8	46.7	17.0	41.9	3,065	1,562	1,503	51.0	6.10	18
23.4	31.8	11.9	28.8	3,959	1,396	2,563	35.3	6.06	19
24.8	57.4	21.2	52.8	3,159	1,959	1,200	62.0	6.07	20
24.0	42.5	2.1	39.0	4,252	1,944	2,308	45.7	6.12	21
25.1	54.0	9.0	50.9	4,847	2,715	2,132	56.0	6.16	22
26.5	46.7	13.8	44.9	3,875	2,105	1,770	54.3	6.22	23
24.1	46.4	3.8	39.9	1,569	769	800	49.0	6.28	24
35.9	66.6	5.4	61.8	2,442	1,764	678	72.2	6.31	25
22.4	86.5	......	86.5	999	853	146	85.4	6.19	26
21.0	50.1	19.8	48.1	3,603	1,791	1,812	49.7	5.95	27
25.0	64.6	28.4	60.7	2,865	1,964	901	68.6	6.08	28
24.8	73.9	18.1	69.9	1,537	1,133	404	73.7	6.20	29
15.0	100.0	37.9	91.6	585	585	....	100.0	5.93	30
23.1	70.7	......	70.7	836	603	233	72.1	7.11	31
......	......	......	......	....	....	....	......	......	32
43.9	100.0	......	100.0	645	645	....	100.0	6.53	33
......	......	......	......	....	....	....	......	......	34
17.2	89.2	49.5	87.5	1,046	981	65	93.8	6.14	35
27.5	77.2	2.3	67.0	700	538	162	76.9	5.78	36
......	......	......	......	....	....	....	......	......	37
......	......	......	......	....	....	....	......	......	38
17.3	52.5	45.7	52.4	1,453	781	672	53.8	6.58	39
			......	48,818	27,128	21,690	......	......	Total
25.1	52.0	13.1	45.6	....	....	....	55.6	6.07	Average

Table 25—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps,

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	29	54	41	60.85	44.61	....	16.24	16.24	....	0.17	0.17	....	16.07	16.07
5	48	56	46	145.53	69.85	....	75.68	75.68	....	2.75	2.75	....	72.93	72.93
6	53	64	49	239.83	87.82	....	152.01	152.01	....	2.79	2.79	....	149.22	149.22
7	39	77	50	247.68	79.22	....	168.46	168.46	....	5.97	5.97	....	162.49	162.49
8	49	80	53	429.25	120.14	....	309.11	309.11	....	15.27	15.27	....	293.84	293.84
9	67	83	58	778.38	192.71	....	585.67	585.67	....	30.81	30.81	....	554.86	554.86
10	55	93	59	821.23	210.53	....	610.70	610.70	....	51.88	51.88	....	558.82	558.82
11	58	103	61	1,104.68	243.44	....	861.24	861.24	....	73.86	73.86	....	787.38	787.38
12	73	124	62	1,618.99	403.83	....	1,215.16	1,215.16	....	146.48	146.48	....	1,068.68	1,068.68
13	72	130	62	1,893.50	466.31	1,005.28	421.91	1,427.19	213.61	52.35	265.96	791.67	369.56	1,161.23
14	56	143	63	1,690.96	380.21	1,030.85	279.90	1,310.75	226.58	20.09	246.67	804.27	259.81	1,064.08
15	69	145	65	2,457.16	582.36	1,567.44	307.36	1,874.80	373.81	21.11	394.92	1,193.63	286.25	1,479.88
16	68	153	67	2,907.90	693.64	1,924.74	289.52	2,214.26	542.36	23.29	565.65	1,382.38	266.23	1,648.61
17	58	159	67	2,715.20	678.29	1,800.65	236.26	2,036.91	606.80	28.37	635.17	1,193.85	207.89	1,401.74
18	62	179	69	3,354.70	781.61	2,318.96	254.13	2,573.09	785.07	35.32	820.39	1,533.89	218.81	1,752.70
19	54	171	70	3,315.20	766.49	2,376.39	172.32	2,548.71	989.68	16.15	1,005.83	1,386.71	156.17	1,542.88
20	50	185	71	3,344.00	852.26	2,336.63	155.11	2,491.74	1,087.28	17.53	1,104.81	1,249.35	137.58	1,386.93
21	49	185	69	3,563.10	781.43	2,562.05	219.62	2,781.67	1,195.48	35.38	1,230.86	1,366.57	184.24	1,550.81
22	35	201	73	2,840.40	626.26	2,150.77	63.37	2,214.14	821.80	8.98	830.78	1,328.97	54.39	1,383.36
23	34	205	74	3,084.30	787.88	2,179.96	116.46	2,296.42	963.70	12.38	976.08	1,216.26	104.08	1,320.34
24	21	216	73	2,007.60	539.45	1,429.50	38.65	1,468.15	569.58	2.56	572.14	859.92	36.09	896.01
25	28	215	75	2,988.70	694.70	2,202.34	91.66	2,294.00	810.58	5.58	816.16	1,391.76	86.08	1,477.84
26	15	241	73	1,692.30	411.30	1,252.58	28.42	1,281.00	531.28	4.18	535.46	721.30	24.24	745.54
27	11	220	76	1,404.20	357.99	1,010.98	35.23	1,046.21	633.95	13.02	646.97	377.03	22.21	399.24
28	7	248	75	909.60	253.91	645.70	9.99	655.69	380.97	....	380.97	264.73	9.99	274.72
29	8	231	78	1,109.80	289.39	807.58	12.83	820.41	499.60	1.23	500.83	307.98	11.60	319.58
30	2	275	71	270.30	59.03	211.27	....	211.27	109.08	....	109.08	102.19	....	102.19
31	.	.	.	....	....	....	....	....	....	....	....	....	....	....
32	4	279	81	774.00	213.23	549.66	11.11	560.77	335.31	11.11	346.42	214.35	....	214.35
33	1	275	75	196.80	80.18	116.62	....	116.62	26.70	....	26.70	89.92	....	89.92
34	1	300	80	227.20	90.20	137.00	....	137.00	43.17	....	43.17	93.83	....	93.83
35	1	250	99	283.40	100.90	182.50	....	182.50	73.98	....	73.98	108.52	....	108.52
Total	1,177	......	....	48,476.74	11,939.17	29,799.45	6,738.12	36,537.57	11,820.37	638.61	12,458.98	17,979.08	6,099.51	24,078.59
Average	....	......	....	....	....	....	....	....	....	....	....	....	....	....

ELLOW BIRCH

nd Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

LGONQUIN ECOLOGICAL SECTION

Percentage				Volume in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Tops and Stumps in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
73.3	......	1.0	1.0	....	....	....	......	......	4
48.0	......	3.6	3.6	....	....	....	......	......	5
36.6	......	1.8	1.8	....	....	....	......	......	6
32.0	......	3.5	3.5	....	....	....	......	......	7
28.0	......	4.9	4.9	....	....	....	......	......	8
24.8	......	5.3	5.3	....	....	....	......	......	9
25.6	......	8.5	8.5	....	....	....	......	......	10
22.0	......	8.6	8.6	....	....	....	......	......	11
24.9	......	12.1	12.1	....	....	....	......	......	12
24.6	21.2	12.4	18.6	5,427	1,356	4,071	25.0	5.40	13
22.5	22.0	7.2	18.8	5,598	1,424	4,174	25.4	5.43	14
23.7	23.8	6.9	21.1	8,687	2,514	6,173	28.9	5.54	15
23.9	28.2	8.0	25.5	10,935	3,557	7,378	32.5	5.68	16
25.0	33.7	12.0	31.2	10,263	3,776	6,487	36.8	5.70	17
23.3	33.9	13.9	31.9	13,502	5,421	8,081	40.1	5.82	18
23.1	41.6	9.4	39.5	13,971	6,411	7,560	45.9	5.88	19
25.5	46.5	11.3	44.3	13,171	6,821	6,350	51.8	5.64	20
21.9	46.7	16.1	44.2	15,351	7,794	7,557	50.8	5.99	21
22.0	38.2	14.2	37.5	12,935	5,683	7,252	43.9	6.01	22
25.5	44.2	10.6	42.5	12,840	6,268	6,572	48.8	5.89	23
26.9	39.8	6.6	39.0	9,401	3,819	5,582	40.6	6.58	24
23.2	36.8	6.1	35.6	13,329	5,416	7,913	40.6	6.05	25
24.3	42.4	14.7	41.8	7,631	3,611	4,020	47.3	6.09	26
25.5	62.7	37.0	61.8	6,115	3,991	2,124	65.3	6.05	27
27.9	59.0	......	58.1	4,009	2,510	1,499	62.6	6.21	28
26.1	61.9	9.6	61.0	4,946	3,140	1,806	63.5	6.12	29
21.8	51.6	......	51.6	1,201	682	519	56.8	5.68	30
....	......	......	......	....	....	....	......	......	31
27.5	61.0	100.0	61.8	3,453	2,315	1,138	67.0	6.28	32
40.7	22.9	......	22.9	735	314	421	42.7	6.30	33
39.7	31.5	......	31.5	884	344	540	38.9	6.45	34
35.6	40.5	......	40.5	1,110	553	557	49.8	6.08	35
....	......	......	......	175,494	77,720	97,774	......	......	Total
24.6	39.7	9.5	34.1	....	....	....	44.3	5.89	Average

Table 26—

Average Volume per Tree in Cubic Feet and Board Feet, Percentages of Tops, Stumps, and Cull,

ALL SITES COMBINED —

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	1	52	43	1.31	0.87	....	0.44	0.44	....	0.01	0.01	....	0.43	0.43
5	7	64	48	2.01	0.91	....	1.10	1.10	....	0.03	0.03	....	1.07	1.07
6	6	77	52	3.82	1.36	....	2.46	2.46	....	0.07	0.07	....	2.39	2.39
7	3	89	55	6.04	1.83	....	4.21	4.21	....	0.13	0.13	....	4.08	4.08
8	7	101	57	8.61	2.41	....	6.20	6.20	....	0.28	0.28	....	5.92	5.92
9	3	113	60	11.26	2.97	....	8.29	8.29	....	0.50	0.50	....	7.79	7.79
10	5	123	62	14.06	3.56	....	10.50	10.50	....	0.87	0.87	....	9.63	9.63
11	11	134	63	17.32	4.32	....	13.00	13.00	....	1.53	1.53	....	11.47	11.47
12	10	144	65	20.86	5.14	....	15.72	15.72	....	2.46	2.46	....	13.26	13.26
13	14	154	66	25.05	6.16	12.52	6.37	18.89	3.05	0.82	3.87	9.47	5.55	15.02
14	13	164	67	29.63	7.25	16.03	6.35	22.38	4.69	0.82	5.51	11.34	5.53	16.87
15	12	173	69	34.34	8.34	19.67	6.33	26.00	6.48	0.82	7.30	13.19	5.51	18.70
16	17	182	70	39.31	9.53	23.47	6.31	29.78	8.49	0.82	9.31	14.98	5.49	20.47
17	11	191	70	44.71	10.87	27.57	6.27	33.84	10.77	0.82	11.59	16.80	5.45	22.25
18	16	200	71	50.56	12.35	32.02	6.19	38.21	13.41	0.81	14.22	18.61	5.38	23.99
19	18	208	72	56.75	14.00	36.59	6.16	42.75	16.23	0.82	17.05	20.36	5.34	25.70
20	13	216	73	62.97	15.57	41.36	6.04	47.40	19.30	0.82	20.12	22.06	5.22	27.28
21	14	224	74	69.44	17.25	46.24	5.95	52.19	22.58	0.82	23.40	23.66	5.13	28.79
22	14	231	74	76.12	18.96	51.29	5.87	57.16	26.22	0.82	27.04	25.07	5.05	30.12
23	10	239	75	83.13	20.79	56.51	5.83	62.34	30.11	0.83	30.94	26.40	5.00	31.40
24	4	246	76	90.37	22.68	61.90	5.79	67.69	34.32	0.85	35.17	27.58	4.94	32.52
25	7	253	77	97.91	24.67	67.50	5.74	73.24	38.74	0.87	39.61	28.76	4.87	33.63
26	2	260	77	105.72	26.80	73.30	5.62	78.92	43.59	0.89	44.48	29.71	4.73	34.44
27	8	268	78	113.73	29.00	79.25	5.48	84.73	48.75	0.90	49.65	30.50	4.58	35.08
28	6	275	78	122.54	31.43	85.73	5.38	91.11	54.43	0.92	55.35	31.30	4.46	35.76
29	3	282	79	131.86	33.95	92.68	5.23	97.91	60.63	0.94	61.57	32.05	4.29	36.34
30	1	290	80	141.39	36.56	99.69	5.14	104.83	67.20	0.98	68.18	32.49	4.16	36.65
31	1	297	80	151.29	39.26	106.99	5.04	112.03	74.29	1.01	75.30	32.70	4.03	36.73
32	....	304	81	161.60	42.10	114.52	4.98	119.50	81.79	1.06	82.85	32.73	3.92	36.65
33	1	312	81	172.06	44.99	122.15	4.92	127.07	89.71	1.12	90.83	32.44	3.80	36.24
34	....	319	82	182.97	48.05	130.09	4.83	134.92	98.14	1.16	99.30	31.95	3.67	35.62
35	1	326	83	193.94	51.20	138.00	4.74	142.74	106.86	1.21	108.07	31.14	3.53	34.67
36	1	334	83	205.54	54.67	146.20	4.67	150.87	116.11	1.26	117.37	30.09	3.41	33.50
37	....	341	84	217.01	57.95	154.50	4.56	159.06	125.75	1.30	127.05	28.75	3.26	32.01
38	....	348	84	228.75	61.40	162.90	4.45	167.35	135.80	1.34	137.14	27.10	3.11	30.21
39	1	356	85	240.59	64.84	171.41	4.34	175.75	146.17	1.38	147.55	25.24	2.96	28.20

ELLOW BIRCH

nd Conversion Factors from Board Feet to Cubic Feet, by Diameter Classes; Curved Values

LGOMA ECOLOGICAL SECTION

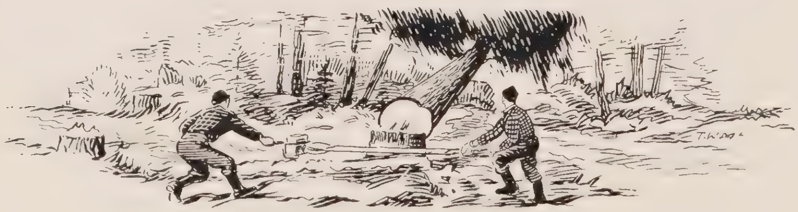
Percentage				Volume per Tree in Board Feet, Ontario Rule			Percentage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Top and Stump in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
66.4	......	2.3	2.3	......	......	......	......	......	4
45.3	......	2.7	2.7	......	......	......	......	......	5
35.6	......	2.8	2.8	......	......	......	......	......	6
30.3	......	3.1	3.1	......	......	......	......	......	7
28.0	......	4.5	4.5	......	......	......	......	......	8
26.4	......	6.0	6.0	......	......	......	......	......	9
25.3	......	8.3	8.3	......	......	......	......	......	10
24.9	......	11.8	11.8	......	......	......	......	......	11
24.6	......	15.6	15.6	......	......	......	......	......	12
24.6	24.4	12.9	20.5	69	21	48	30.4	5.51	13
24.5	29.3	12.9	24.6	90	31	59	34.4	5.61	14
24.3	32.9	13.0	28.1	111	42	69	37.8	5.64	15
24.2	36.2	13.0	31.3	136	55	81	40.4	5.79	16
24.3	39.1	13.1	34.2	164	71	93	43.3	5.95	17
24.4	41.9	13.1	37.2	191	87	104	45.5	5.97	18
24.7	44.4	13.3	39.9	221	106	115	48.0	6.04	19
24.7	46.7	13.6	42.4	250	125	125	50.0	6.04	20
24.8	48.8	13.8	44.8	282	147	135	52.1	6.10	21
24.9	51.1	14.0	47.3	314	170	144	54.1	6.12	22
25.0	53.3	14.2	49.6	347	195	152	56.2	6.14	23
25.1	55.4	14.7	52.0	382	222	160	58.1	6.17	24
25.2	57.4	15.2	54.1	418	251	167	60.0	6.19	25
25.3	59.5	15.8	56.4	455	282	173	62.0	6.21	26
25.5	61.5	16.4	58.6	492	315	177	64.0	6.21	27
25.6	63.5	17.1	60.8	533	351	182	65.9	6.22	28
25.7	65.4	18.0	62.9	577	392	185	67.9	6.23	29
25.9	67.4	19.1	65.0	621	435	186	70.0	6.23	30
26.0	69.4	20.0	67.2	667	480	187	72.0	6.23	31
26.1	71.4	21.3	69.3	714	528	186	73.9	6.23	32
26.1	73.4	22.8	71.5	761	578	183	76.0	6.23	33
26.3	75.4	24.0	73.6	811	633	178	78.1	6.23	34
26.4	77.4	25.5	75.7	862	690	172	80.0	6.25	35
26.6	79.4	27.0	77.8	915	751	164	82.1	6.26	36
26.7	81.4	28.5	79.9	969	815	154	84.1	6.27	37
26.8	83.4	30.1	81.9	1,025	882	143	86.0	6.29	38
27.0	85.3	31.8	84.0	1,081	953	128	88.2	6.31	39

Table 27—

Average Volume per Tree in Cubic Feet and Board Feet, Percentages of Tops, Stumps, and Cull,

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet										
				Gross Total	Top and Stump	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	29	39	41	1.66	1.24	....	0.42	0.42	....	0.01	0.01	....	0.41	0.41
5	48	50	45	3.12	1.41	....	1.71	1.71	....	0.04	0.04	....	1.67	1.67
6	53	60	49	4.89	1.75	....	3.14	3.14	....	0.08	0.08	....	3.06	3.06
7	39	70	52	6.96	2.14	....	4.82	4.82	....	0.15	0.15	....	4.67	4.67
8	49	81	55	9.15	2.53	....	6.62	6.62	....	0.24	0.24	....	6.38	6.38
9	67	91	57	11.81	3.07	....	8.74	8.74	....	0.41	0.41	....	8.33	8.33
10	55	101	59	14.74	3.67	....	11.07	11.07	....	0.70	0.70	....	10.37	10.37
11	58	111	60	18.19	4.39	....	13.80	13.80	....	1.28	1.28	....	12.52	12.52
12	73	121	61	22.09	5.29	....	16.80	16.80	....	2.27	2.27	....	14.53	14.53
13	72	130	63	26.66	6.31	14.93	5.42	20.35	3.20	0.48	3.68	11.73	4.94	16.67
14	56	139	64	31.31	7.43	18.95	4.93	23.88	4.82	0.46	5.28	14.13	4.47	18.60
15	69	147	65	36.39	8.63	23.06	4.70	27.76	6.58	0.45	7.03	16.48	4.25	20.73
16	68	155	66	41.74	9.91	27.47	4.36	31.83	8.43	0.44	8.87	19.04	3.92	22.96
17	58	162	67	47.48	11.26	32.10	4.12	36.22	10.44	0.44	10.88	21.66	3.68	25.34
18	62	170	69	53.64	12.73	37.05	3.86	40.91	12.68	0.43	13.11	24.37	3.43	27.80
19	54	177	70	59.87	14.20	42.04	3.63	45.67	15.16	0.43	15.59	26.88	3.20	30.08
20	50	183	70	66.51	15.77	47.27	3.47	50.74	17.95	0.43	18.38	29.32	3.04	32.36
21	49	190	71	73.72	17.47	53.00	3.25	56.25	21.08	0.42	21.50	31.92	2.83	34.75
22	35	198	72	80.84	19.16	58.60	3.08	61.68	24.39	0.42	24.81	34.21	2.66	36.87
23	34	205	73	88.78	21.06	64.77	2.95	67.72	28.13	0.42	28.55	36.64	2.53	39.17
24	21	212	74	97.05	23.37	70.87	2.81	73.68	32.12	0.42	32.54	38.75	2.39	41.14
25	28	219	74	105.85	26.03	77.14	2.68	79.82	36.43	0.42	36.85	40.71	2.26	42.97
26	15	226	75	115.09	29.00	83.58	2.51	86.09	41.05	0.41	41.46	42.53	2.10	44.63
27	11	233	76	124.90	32.33	90.19	2.38	92.57	46.08	0.41	46.49	44.11	1.97	46.08
28	7	240	76	135.21	35.97	97.01	2.23	99.24	51.40	0.41	51.81	45.61	1.82	47.43
29	8	248	77	146.10	40.10	104.00	2.00	106.00	57.07	0.40	57.47	46.93	1.60	48.53
30	2	255	77	158.19	45.01	111.39	1.79	113.18	63.22	0.40	63.62	48.17	1.39	49.56
31	....	262	78	170.59	50.24	118.77	1.58	120.35	69.70	0.40	70.10	49.07	1.18	50.25
32	4	269	78	183.73	55.91	126.44	1.38	127.82	76.54	0.40	76.94	49.90	0.98	50.88
33	1	277	79	197.91	62.42	134.31	1.18	135.49	83.89	0.39	84.28	50.42	0.79	51.21
34	1	284	79	213.30	69.75	142.54	1.01	143.55	91.80	0.39	92.19	50.74	0.62	51.36
35	1	291	80	230.12	78.29	151.01	0.82	151.83	100.14	0.39	100.53	50.87	0.43	51.30



ELLOW BIRCH

d Conversion Factors from Board Feet to Cubic Feet, by Diameter Classes; Curved Values

GONQUIN ECOLOGICAL SECTION

Percentage				Volume per Tree in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Top and Stump in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
74.7	......	2.4	2.4	......	......	......	......	......	4
45.2	......	2.3	2.3	......	......	......	......	......	5
35.8	......	2.5	2.5	......	......	......	......	......	6
30.7	......	3.1	3.1	......	......	......	......	......	7
27.7	......	3.6	3.6	......	......	......	......	......	8
26.0	......	4.7	4.7	......	......	......	......	......	9
24.9	......	6.3	6.3	......	......	......	......	......	10
24.1	......	9.3	9.3	......	......	......	......	......	11
23.9	......	13.5	13.5	......	......	......	......	......	12
23.7	21.4	8.9	18.1	75	18	57	24.0	5.02	13
23.7	25.4	9.3	22.1	101	29	72	28.7	5.33	14
23.7	28.5	9.6	25.3	129	42	87	32.6	5.59	15
23.7	30.7	10.1	27.9	157	55	102	35.0	5.72	16
23.7	32.5	10.7	30.0	186	70	116	37.6	5.79	17
23.7	34.2	11.1	32.0	218	86	132	39.4	5.88	18
23.7	36.1	11.8	34.1	249	102	147	41.0	5.92	19
23.7	38.0	12.4	36.2	282	121	161	42.9	5.97	20
23.7	39.8	12.9	38.2	317	141	176	44.5	5.98	21
23.7	41.6	13.6	40.2	351	162	189	46.2	5.99	22
23.7	43.4	14.2	42.2	389	186	203	47.8	6.01	23
24.1	45.3	14.9	44.2	427	212	215	49.6	6.03	24
24.6	47.2	15.7	46.2	467	240	227	51.4	6.05	25
25.2	49.1	16.3	48.2	507	268	239	52.9	6.07	26
25.9	51.1	17.2	50.2	548	300	248	54.7	6.08	27
26.6	53.0	18.4	52.2	591	333	258	56.3	6.09	28
27.4	54.9	20.0	54.2	634	369	265	58.2	6.10	29
28.5	56.8	22.3	56.2	680	407	273	59.9	6.10	30
29.5	58.7	25.3	58.2	727	448	279	61.6	6.12	31
30.4	60.5	29.0	60.2	774	491	283	63.4	6.12	32
31.5	62.5	33.1	62.2	823	536	287	65.1	6.13	33
32.7	64.4	38.6	64.2	875	584	291	66.7	6.14	34
34.0	66.3	47.6	66.2	928	636	292	68.5	6.15	35

Hemlock

This species forms a common admixture in the tolerant hardwood stands of the Algonquin Ecological Section, where it generally occurs on ridges and upper slopes. The occurrence of hemlock in the Algoma Section is noticeably less frequent.

As hemlock is utilized almost exclusively for sawtimber, it was treated as such in the course of this survey. The total sample of hemlock from both the Algoma and Algonquin Ecological Sections amounted to 387 trees.

Diameter Breast Height

The volumetric relationship of cull to 1-inch diameter classes is shown in Table 28. Only data in cubic feet from the total gross merchantable, cull, and net merchantable volumes were used to construct the graphs in Figs. 38 and 39. The data obtained from these graphs are shown in Table 29 for use in management. Because of the relatively small number of sample trees in the larger diameter classes, the data in Table 29 are not given separately

Table 28–

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stump

ALL SITES COMBINED-

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet										
				Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	15	88	26	17.60	14.96	....	2.64	2.64	....	0.18	0.18	....	2.46	2.4
5	21	120	29	41.72	19.93	....	21.79	21.79	....	1.62	1.62	....	20.17	20.1
6	38	123	34	122.36	47.14	....	75.22	75.22	....	5.04	5.04	....	70.18	70.1
7	39	144	38	186.92	56.02	....	130.90	130.90	....	9.32	9.32	....	121.58	121.5
8	27	151	41	188.63	48.34	....	140.29	140.29	....	9.61	9.61	....	130.68	130.6
9	32	156	45	296.84	65.81	....	231.03	231.03	....	15.73	15.73	....	215.30	215.3
10	33	161	51	404.67	75.17	....	329.50	329.50	....	25.79	25.79	....	303.71	303.7
11	35	178	52	577.93	98.42	....	479.51	479.51	....	79.33	79.33	....	400.18	400.1
12	34	183	57	678.34	103.90	....	574.44	574.44	....	142.46	142.46	....	431.98	431.9
13	22	188	57	557.30	100.15	386.60	70.55	457.15	74.65	9.08	83.73	311.95	61.47	373.4
14	26	210	61	790.60	98.51	594.14	97.95	692.09	82.72	3.94	86.66	511.42	94.01	605.4
15	15	199	60	518.20	76.44	412.06	29.70	441.76	81.36	1.77	83.13	330.70	27.93	358.6
16	7	175	67	304.20	32.90	248.13	23.17	271.30	44.54	1.04	45.58	203.59	22.13	225.7
17	12	209	69	583.00	58.97	488.56	35.47	524.03	54.01	....	54.01	434.55	35.47	470.0
18	8	231	83	434.10	45.04	359.81	29.25	389.06	44.71	....	44.71	315.10	29.25	344.3
19	9	220	71	578.90	51.11	505.84	21.95	527.79	67.30	0.75	68.05	438.54	21.20	459.7
20	1	230	82	73.00	6.35	61.55	5.10	66.65	18.21	....	18.21	43.34	5.10	48.4
21	6	308	70	475.70	54.04	413.53	8.13	421.66	130.04	0.90	130.94	283.49	7.23	290.7
22	2	261	75	147.10	12.21	123.50	11.39	134.89	15.46	....	15.46	108.04	11.39	119.4
23	1	260	65	76.20	9.48	63.19	3.53	66.72	18.58	....	18.58	44.61	3.53	48.1
24														
25														
26	....	.....	....	....	....	....	....	....	....	....	....	....	....	....
27	2	242	78	261.80	35.01	216.32	10.47	226.79	43.21	....	43.21	173.11	10.47	183.5
28	....			....	....	....	....	....	....	....	....			
29	2	280	77	334.40	39.05	289.98	5.37	295.35	161.72	....	161.72	128.26	5.37	133.6
Total	387	......	....	7,649.51	1,148.95	4,163.21	2,337.35	6,500.56	836.51	306.56	1,143.07	3,326.70	2,030.79	5,357.4
Average		....												

for logs and pulp in both cubic foot and board foot measures. The average cull for sawlogs in the sample was 20 per cent. A fairly consistent increase of cull with tree diameter is evident when Table 29 and Fig. 39 are examined.

The amount of cull in hemlock shown in Tables 28 and 29 and in Fig. 39, includes losses of merchantable volume caused by shake, which is particularly common in larger overmature trees. It should, however, be pointed out that shake does not extend far up the trunk, and therefore the losses because of this defect were less than was anticipated.

Site

The sample of hemlock was insufficient to compare cull in trees growing on different sites. However, the available information did not indicate that the variations in the degree of cull on the different sites where hemlock occurs are of practical importance.

MLOCK

d Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

GOMA AND ALGONQUIN ECOLOGICAL SECTION

Percentage				Volume in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Tops and Stumps n Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
85.0	......	6.8	6.8	....	....	....	......	......	4
47.8	......	7.4	7.4	....	....	....	......	......	5
38.5	......	6.7	6.7	....	....	....	......	......	6
30.0	......	7.1	7.1	....	....	....	......	......	7
25.6	......	6.9	6.9	....	....	....	......	......	8
22.2	......	6.8	6.8	....	....	....	......	......	9
18.6	......	7.8	7.8	....	....	....	......	......	10
17.0	......	16.5	16.5	....	....	....	......	......	11
15.3	......	24.8	24.8	....	....	....	......	......	12
18.0	19.3	12.9	18.3	2,012	488	1,524	24.3	5.20	13
12.5	13.9	4.0	12.5	3,133	564	2,569	18.0	5.27	14
14.8	19.7	6.0	18.8	2,255	525	1,730	23.3	5.47	15
10.8	18.0	4.5	16.8	1,398	293	1,105	21.0	5.63	16
10.1	11.1	......	10.3	2,731	340	2,391	12.4	5.59	17
10.4	12.4	......	11.5	2,058	395	1,663	19.2	5.72	18
8.8	13.3	3.4	12.9	2,717	464	2,253	17.1	5.37	19
8.7	29.6	......	27.3	353	129	224	36.5	5.74	20
11.4	31.4	11.1	31.1	2,384	906	1,478	38.0	5.76	21
8.3	12.5	......	11.5	722	118	604	16.3	5.85	22
12.4	29.4	......	27.8	378	161	217	42.6	5.98	23
									24
......	......	......	......	....	....	....	......	.....	25
......	......	......	......	....	....	....	......	......	26
13.4	20.0	......	19.1	1,322	284	1,038	21.5	6.11	27
....	......	......	......	....	....	....	......	......	28
11.7	55.8	......	54.8	1,845	993	852	53.8	6.36	29
......	......	......	......	23,308	5,660	17,648	......	......	Total
15.0	20.1	13.1	17.6	....	....	....	24.3	5.60	Average

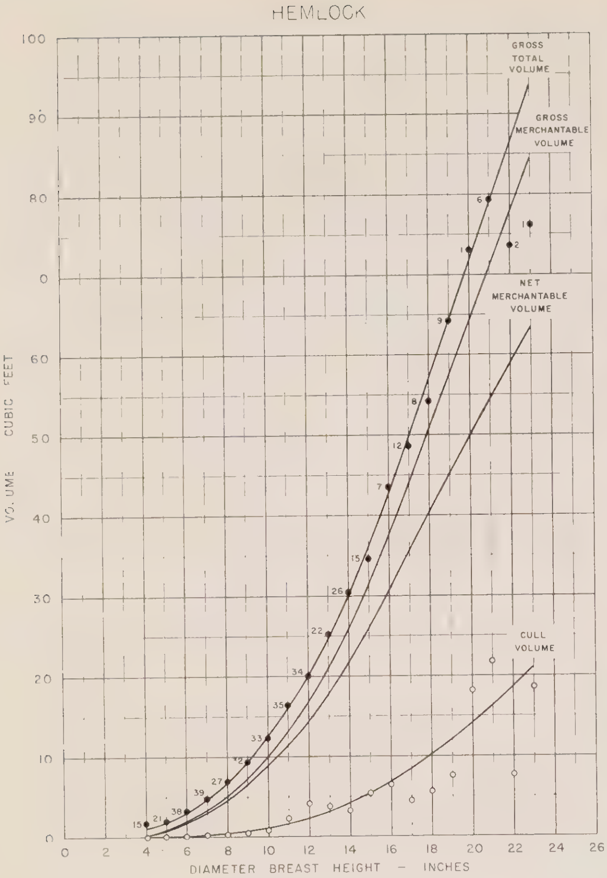


FIG. 38. — *Average volume per tree in relation to D.B.H. All sites combined — Algoma and Algonquin Ecological Sections.*

Mature hemlock, Algonquin Ecological Section.

Transverse section of hemlock with red heart rot.

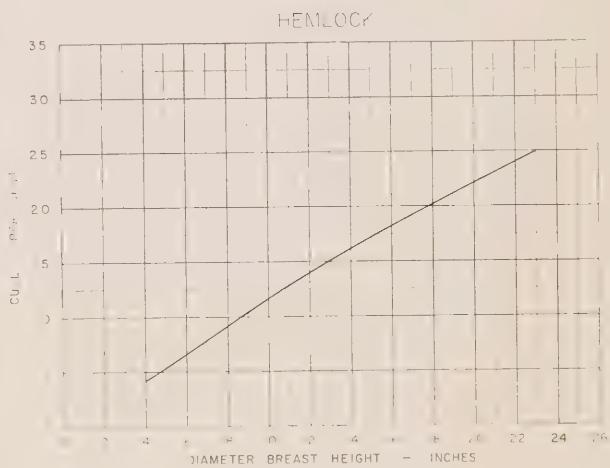


FIG. 39. — *Cull as a percentage of the gross merchantable volume in relation to D.B.H. Average of all sites — Algoma and Algonquin Ecological Sections combined.*

Table 29—HEMLOCK

Average Volume per Tree in Cubic Feet and Percentages of Tops, Stumps, and Cull by Diameter Classes; Curved Values

ALL SITES COMBINED—ALGOMA AND ALGONQUIN ECOLOGICAL SECTIONS

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
4	15	94	25	1.14	0.90	0.24	0.01	0.23	78.9	4.2
5	21	112	30	1.85	0.91	0.94	0.05	0.89	49.2	5.3
6	38	127	34	3.13	1.15	1.98	0.13	1.85	36.7	6.6
7	39	139	38	4.70	1.35	3.35	0.26	3.09	28.7	7.8
8	27	150	42	6.74	1.68	5.06	0.46	4.60	24.9	9.1
9	32	160	46	9.37	2.06	7.31	0.75	6.56	22.0	10.3
10	33	169	49	12.60	2.48	10.12	1.17	8.95	19.7	11.6
11	35	177	52	16.09	2.87	13.22	1.69	11.53	17.8	12.8
12	34	184	55	20.05	3.30	16.75	2.34	14.41	16.5	14.0
13	22	192	58	24.82	3.79	21.03	3.17	17.86	15.3	15.1
14	26	198	61	30.25	4.29	25.96	4.21	21.75	14.2	16.2
15	15	205	63	36.34	4.77	31.57	5.44	26.13	13.1	17.2
16	7	211	66	42.89	5.23	37.66	6.86	30.80	12.2	18.2
17	12	217	68	49.82	5.74	44.08	8.42	35.66	11.5	19.1
18	8	223	70	56.95	6.23	50.72	10.25	40.47	10.9	20.2
19	9	229	71	64.30	6.78	57.52	12.13	45.39	10.5	21.1
20	1	235	73	71.46	7.31	64.15	14.15	50.00	10.2	22.1
21	6	240	74	78.72	7.90	70.82	16.32	54.50	10.0	23.0
22	2	245	75	86.21	8.49	77.72	18.63	59.09	9.8	24.0
23	1	250	76	93.73	9.12	84.61	21.12	63.49	9.7	25.0

Lesser Species of the Tolerant Hardwood Area

The tolerant hardwood stands of the southern portion of Ontario contain a variety of species, most of which occur as a scattered admixture, and therefore are utilized in small quantities, even though the economic value of some of these species may be quite high.

Basswood and beech occur more frequently, but only the former is used in any large quantity by the lumber industry. The remainder of the species listed below are minor components of the total lumber production, although some have a very high value for specific purposes.

The samples of black cherry (22 trees), red maple (66 trees), red oak (42 trees), and white elm (62 trees) were too small to analyse for the relation of cull to D.B.H. and to site, or even to arrive at reliable average cull factors. Therefore, these species will not be considered further in this report.

Aspen

Aspen appears frequently in the Algoma and Algonquin Ecological Sections, either in the form of pure stands or in association with white birch, white pine, spruce, and balsam fir; scattered admixtures of aspen in tolerant hardwood stands can also be found. In general, however, aspen is confined to dry site conditions in these areas.

The total sample of aspen, 115 trees, was obtained in one specific area in the Algonquin Ecological Section. Table 30 summarizes the observations from this area, which are too sparse for further analysis. The average cull of 14 per cent may not be reliable, as over 70 per cent of the sampled trees pertain to the 41–60 years age class.

Table 30—ASPEN

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED—ALGONQUIN ECOLOGICAL SECTION

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	2	40	57	5.9	11.89	3.86	8.03	....	8.03	32.5	......
41–60	83	58	66	7.9	865.53	220.57	644.96	69.43	575.53	25.5	10.8
61–80	29	67	68	9.1	442.68	102.59	340.09	48.85	291.24	23.2	14.4
81–100	1	100	48	17.7	51.50	7.39	44.11	23.84	20.27	14.3	54.0
101–120	....	......	....	......	....	....	....	....	....	......	......
121–140	....	......	....	......	....	....	....	....	....	......	......
141–160	....	......	....	......	....	....	....	....	....	......	......
161+	....	......	....	......	....	....	....	....	....	......	......
Total	115	......	....	......	1,371.60	334.41	1,037.19	142.12	895.07	......	......
Average		......	....	......	....	....	....	....	....	24.4	13.7

Balsam Fir

Balsam fir forms a common admixture of the understory in tolerant hardwood and mixedwood stands in both the Algoma and Algonquin Ecological Sections. The total sample of balsam fir, 249 trees, obtained in these two sections was small, because it was limited to trees encountered in stands of other species.

When examining Table 31, which shows the volumetric relationship of cull to age, it is evident that results obtained in the Algoma and Algonquin Sections are very close to the data pertaining to cull in balsam in the Boreal Forest Region.

Consequently, it is suggested that the information provided in Table 13 for balsam fir in the Boreal Forest Region may also be used for this species in the Algoma and Algonquin Ecological Sections.

Table 31—BALSAM FIR

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED—ALGOMA AND ALGONQUIN ECOLOGICAL SECTIONS

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	10	38	30	4.2	15.72	10.56	5.16	0.39	4.77	67.2	7.6
41–60	107	52	38	5.2	379.33	139.91	239.42	10.38	229.04	36.9	4.3
61–80	68	71	39	5.8	283.15	90.05	193.10	18.45	174.65	31.8	9.6
81–100	40	92	43	6.3	205.06	52.97	152.09	14.81	137.28	25.8	9.7
101–120	18	112	50	7.6	148.27	37.53	110.74	19.64	91.10	25.3	17.7
121–140	5	131	49	8.3	39.72	11.86	27.86	9.89	17.97	29.9	35.5
141–160	1	150	54	9.5	12.24	3.23	9.01	3.28	5.73	26.4	36.4
161+		....	...	...	....	....	....	....	....	......	......
Total	249	......	....	....	1,083.49	346.11	737.38	76.84	660.54	......	......
Average	......	......	....	....	....	....	....	....	....	31.9	10.4

Overmature tolerant hardwood stand, Algonquin Ecological Section.

Basswood

This species occurs as a scattered admixture in sugar maple-yellow birch stands of the Algonquin Ecological Section. Its occurrence is more frequent in the southern portion of this section on fresh, deep, loamy soils.

As basswood is utilized almost entirely for saw-timber, it was treated as such in the course of the survey. To secure data representing closer utilization, small quantities of pulpwood were cut from tops and larger limbs. The total sample of basswood cut in this section amounted to 140 trees.

Table 32—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps,

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merchantable: Logs	Gross Merchantable: Pulp	Gross Merchantable: Total	Cull: Logs	Cull: Pulp	Cull: Total	Net Merchantable: Logs	Net Merchantable: Pulp	Net Merchantable: Total
4	9	41	41	14.74	13.68	....	1.06	1.06	....	....	....	....	1.06	1.06
5	11	42	45	26.88	15.28	....	11.60	11.60	....	0.62	0.62	....	10.98	10.98
6	11	54	46	43.35	16.11	....	27.24	27.24	....	1.22	1.22	....	26.02	26.02
7	8	52	57	47.09	14.57	....	32.52	32.52	....	0.71	0.71	....	31.81	31.81
8	4	54	60	34.38	9.78	....	24.60	24.60	....	0.30	0.30	....	24.30	24.30
9	6	78	69	69.52	16.26	....	53.26	53.26	....	1.59	1.59	....	51.67	51.67
10	7	60	71	105.66	21.64	....	84.02	84.02	....	2.12	2.12	....	81.90	81.90
11	9	72	70	158.38	30.58	....	127.80	127.80	....	7.03	7.03	....	120.77	120.77
12	9	79	75	230.78	46.13	....	184.65	184.65	....	14.66	14.66	....	169.99	169.99
13	11	82	79	342.00	62.52	205.22	74.26	279.48	12.95	1.23	14.18	192.27	73.03	265.30
14	9	80	81	304.60	49.61	205.12	49.87	254.99	21.03	0.30	21.33	184.09	49.57	233.66
15	9	104	79	336.20	46.55	239.26	50.39	289.65	20.01	0.87	20.88	219.25	49.52	268.77
16	3	104	78	133.00	26.41	99.78	6.81	106.59	8.22	....	8.22	91.56	6.81	98.37
17	4	76	90	208.80	27.81	163.46	17.53	180.99	10.43	0.38	10.81	153.03	17.15	170.18
18	3	97	90	206.40	45.00	161.40	....	161.40	12.83	....	12.83	148.57	....	148.57
19	5	103	88	343.80	62.64	256.09	25.07	281.16	7.89	....	7.89	248.20	25.07	273.27
20	....	....	....	....	....	....	....	....	....	....	....	....	....	....
21	4	158	83	308.20	50.30	254.36	3.54	257.90	34.13	....	34.13	220.23	3.54	223.77
22	3	172	85	328.00	65.46	262.54	....	262.54	155.39	....	155.39	107.15	....	107.15
23	5	158	94	566.60	141.43	417.09	8.08	425.17	119.80	....	119.80	297.29	8.08	305.37
24	5	148	86	450.40	93.80	345.31	11.29	356.60	188.71	2.97	191.68	156.60	8.32	164.92
25	....	....	....	....	....	....	....	....	....	....	....	....	....	....
26	3	177	92	408.60	90.25	318.35	....	318.35	109.10	....	109.10	209.25	....	209.25
27	....	....	....	....	....	....	....	....	....	....	....	....	....	....
28	1	178	108	179.00	43.92	135.08	....	135.08	....	....	....	135.08	....	135.08
29	1	130	87	128.20	22.25	88.49	17.46	105.95	27.43	....	27.43	61.06	17.46	78.52
Total	140	....	....	4,974.58	1,011.98	3,151.55	811.05	3,962.60	727.92	34.00	761.92	2,423.63	777.05	3,200.68
Average	....	....	....	....	....	....	....	....	....	....	....	....	....	....

Diameter Breast Height

The volumetric relationship of cull to D.B.H. is shown in Table 32. As may be seen in this table, the sample of basswood trees in different D.B.H. classes is too small to obtain reliable volume and cull percentage graphs. Consequently, only the average cull is available, which for sawlogs is 23 per cent.

Site

The characteristic requirements of this species with respect to site limit its occurrence to only one or possibly two groups of sites, i.e., fresh and moist. In any case, the data secured were insufficient to permit analysis of cull in basswood in relation to different sites.

ASSWOOD

d Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

GONQUIN ECOLOGICAL SECTION

Percentage				Volume in Board Feet, Ontario Rule			Per-centage	Conversion Factors from Board Feet to Cubic Feet, Gross Merch. Vol.	D.B.H., Inches
Tops and Stumps in Relation to Gross Total Vol.	Cull in Relation to Gross Merch. Volume			Gross Merch.	Cull	Net Merch.	Cull in Rel. to Gross Merch. Vol.		
	Logs	Pulp	Average	Logs	Logs	Logs	Logs	Logs	
92.8	......	......	......	....	....	....	......	......	4
56.8	......	5.3	5.3	....	....	....	......	......	5
37.2	......	4.5	4.5	....	....	....	......	......	6
30.9	......	2.2	2.2	....	....	....	......	......	7
28.4	......	1.2	1.2	....	....	....	......	......	8
23.4	......	3.0	3.0	....	....	....	......	......	9
20.5	......	2.5	2.5	....	....	....	......	......	10
19.3	......	5.5	5.5	....	....	....	......	......	11
20.0	......	7.9	7.9	....	....	....	......	......	12
18.3	6.3	1.7	5.1	1,141	83	1,058	7.3	5.56	13
16.3	10.3	0.6	8.4	1,066	124	942	11.6	5.20	14
13.8	8.4	1.7	7.2	1,302	156	1,146	12.0	5.44	15
19.9	8.2	......	7.7	572	52	520	9.1	5.73	16
13.3	6.4	2.2	6.0	907	67	840	7.4	5.55	17
21.8	7.9	......	7.9	953	101	852	10.6	5.90	18
18.2	3.1	......	2.8	1,497	42	1,455	2.8	5.85	19
......	......	......	......	....	....	....	......	......	20
16.3	13.4	......	13.2	1,488	234	1,254	15.7	5.85	21
20.0	59.2	......	59.2	1,605	950	655	59.2	6.11	22
25.0	28.7	......	28.2	2,502	963	1,539	38.5	6.00	23
20.8	54.6	26.3	53.8	1,956	1,191	765	60.9	5.66	24
......	......	......	......	....	....	....	......	......	25
22.1	34.3	......	34.3	1,890	746	1,144	39.5	5.94	26
......	......	......	......	....	....	....	......	......	27
24.5	......	......	......	880	....	880	......	6.51	28
17.4	31.0	......	25.9	471	200	271	42.5	5.32	29
			......	18,230	4,909	13,321	......	......	Total
20.3	23.1	4.2	19.2	....	....	....	26.9	5.78	Average

Beech

Beech was encountered as a patchy admixture in sugar maple-yellow birch stands in the Algonquin Ecological Section. It occurred on dry and fresh sites, and more commonly on upper slopes.

There has been little demand for beech in the lumber industry in Ontario because this species is generally considered to be highly defective and to produce a somewhat lower-grade lumber (10). In the course of this survey, beech was cut and scaled as sawlogs and pulpwood, depending on the size and quality of sampled trees. The total sample of beech amounted to 393 trees.

Diameter Breast Height

Table 33 shows the volumetric relationship of cull to D.B.H. by 1-inch classes. Only data in cubic feet

Table 33—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet										
				Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	25	65	39	45.82	33.88	....	11.94	11.94	....	1.18	1.18	....	10.76	10.76
5	61	78	43	177.26	87.32	....	89.94	89.94	....	9.99	9.99	....	79.95	79.95
6	56	86	48	252.51	92.50	....	160.01	160.01	....	12.37	12.37	....	147.64	147.64
7	36	95	54	255.96	76.84	....	179.12	179.12	....	11.70	11.70	....	167.42	167.42
8	37	103	57	349.27	101.08	....	248.19	248.19	....	37.54	37.54	....	210.65	210.65
9	29	109	60	372.70	89.07	....	283.63	283.63	....	34.46	34.46	....	249.17	249.17
10	29	114	62	482.98	118.73	....	364.25	364.25	....	56.83	56.83	....	307.42	307.42
11	28	118	67	590.82	127.74	....	463.08	463.08	....	54.28	54.28	....	408.80	408.80
12	26	129	69	701.28	146.09	....	555.19	555.19	....	152.10	152.10	....	403.09	403.09
13	18	126	66	538.60	109.70	330.81	98.09	428.90	74.19	4.80	78.99	256.62	93.29	349.91
14	12	135	75	456.80	102.68	313.75	40.37	354.12	98.83	4.14	102.97	214.92	36.23	251.15
15	14	135	69	522.30	124.50	295.86	101.94	397.80	152.41	55.86	208.27	143.45	46.08	189.53
16	10	154	75	509.20	135.72	341.48	32.00	373.48	85.16	5.58	90.74	256.32	26.42	282.74
17	7	155	71	374.90	83.89	272.36	18.65	291.01	92.06	2.60	94.66	180.30	16.05	196.35
18	....	......	....	....	....	....	....	....	....	....	....	....	....	...
19	2	161	69	136.00	32.07	95.58	8.35	103.93	52.44	0.86	53.30	43.14	7.49	50.63
20	2	171	91	175.80	39.60	127.82	8.38	136.20	52.18	4.71	56.89	75.64	3.67	79.31
21	1	168	83	68.80	13.86	43.76	11.18	54.94	26.19	8.73	34.92	17.57	2.45	20.02
Total	393	......	....	6,011.00	1,515.27	1,821.42	2,674.31	4,495.73	633.46	457.73	1,091.19	1,187.96	2,216.58	3,404.54
Average	....	......	....	....	....	....	....	....	....	....	....	....	....	....

from the total gross merchantable, cull, and net merchantable volumes were used to construct the graphs in Figs. 40 and 41. The curved values tabulated in Table 34 are not given separately for logs and pulp because of the relatively small number of sampled trees in larger diameter classes. The average cull for sawlogs in the sample was 35 per cent.

As may be seen in Table 33 and Fig. 41, the degree of cull increases consistently with size of trees; however, cull in the sampled beech trees was generally less than was expected.

Site

The sample of beech was insufficient to examine cull in trees growing on different sites. However, the available information indicates that more cull may be expected in beech growing on dry, shallow sites, as is commonly found on ridges and upper slopes.

ECH

d Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

GONQUIN ECOLOGICAL SECTION

PERCENTAGE				VOLUME IN BOARD FEET, ONTARIO RULE			PER-CENTAGE	CONVERSION FACTORS FROM BOARD FEET TO CUBIC FEET, GROSS MERCH. VOL.	D.B.H., INCHES
TOPS AND STUMPS IN RELATION TO GROSS TOTAL VOL.	CULL IN RELATION TO GROSS MERCH. VOLUME			GROSS MERCH.	CULL	NET MERCH.	CULL IN REL. TO GROSS MERCH. VOL.		
	LOGS	PULP	AVERAGE	LOGS	LOGS	LOGS	LOGS	LOGS	
73.9	......	9.9	9.9	....	....	....	......	......	4
49.3	......	11.1	11.1	....	....	....	......	......	5
36.6	......	7.7	7.7	....	....	....	......	......	6
30.0	......	6.5	6.5	....	....	....	......	......	7
28.9	......	15.1	15.1	....	....	....	......	......	8
23.9	......	12.1	12.1	....	....	....	......	......	9
24.6	......	15.6	15.6	....	....	....	......	......	10
21.6	......	11.7	11.7	....	....	....	......	......	11
20.8	......	27.4	27.4	....	....	....	......	......	12
20.4	22.4	4.9	18.4	1,899	505	1,394	26.6	5.74	13
22.5	31.5	10.3	29.1	1,862	611	1,251	32.8	5.93	14
23.8	51.5	54.8	52.4	1,766	910	856	51.5	5.97	15
26.7	24.9	17.4	24.3	2,043	623	1,420	30.5	5.98	16
22.4	33.8	13.9	32.5	1,647	658	989	40.0	6.05	17
..	......	......	......	....	....	....	......	......	18
23.6	54.9	10.3	51.3	568	370	198	65.1	5.94	19
22.5	40.8	56.2	41.8	772	309	463	40.0	6.04	20
20.1	59.8	78.1	63.6	282	168	114	59.6	6.44	21
..	..	..	......	10,839	4,154	6,685	......	......	TOTAL
25.2	34.8	17.1	24.3	....	....	....	38.3	5.95	AVERAGE

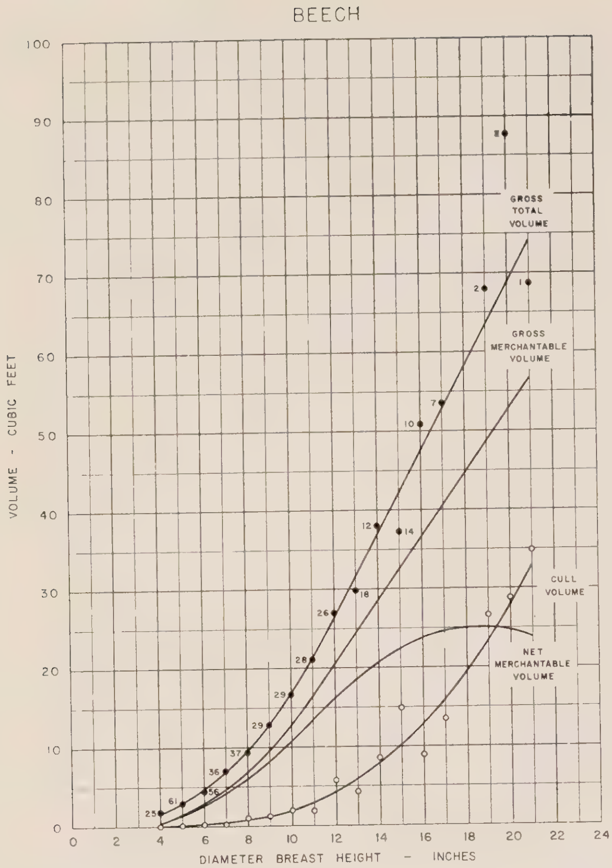


FIG. 40. — *Average volume per tree in relation to D.B.H. All sites combined — Algonquin Ecological Section.*

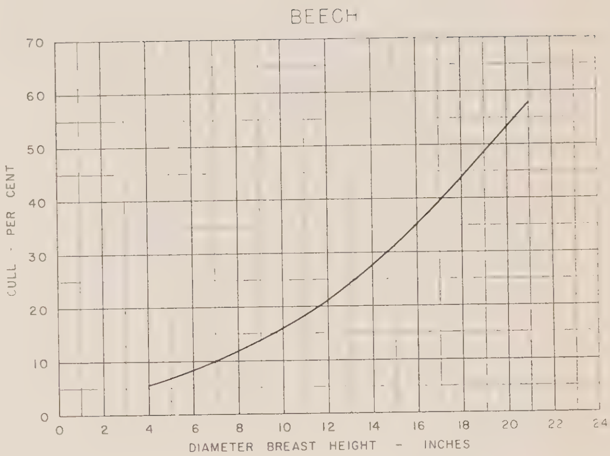


FIG. 41. — *Cull as a percentage of the gross merchantable volume in relation to D.B.H. Average of all sites — Algonquin Ecological Section.*

Grading logs, Algoma Ecological Section.

Table 34—BEECH

Average Volume per Tree in Cubic Feet and Percentages of Tops, Stumps, and Cull by Diameter Classes; Curved Values

ALL SITES COMBINED — ALGONQUIN ECOLOGICAL SECTION

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume per Tree in Cubic Feet: Gross Total	Top and Stump	Gross Merch.	Cull	Net Merch.	Percentage: Top and Stump in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
4	25	69	38	1.60	1.24	0.36	0.02	0.34	77.5	5.6
5	61	79	44	3.00	1.41	1.59	0.11	1.48	47.0	6.9
6	56	87	49	4.70	1.72	2.98	0.25	2.73	36.6	8.4
7	36	94	53	6.80	2.11	4.69	0.47	4.22	31.0	10.0
8	37	101	56	9.50	2.62	6.88	0.81	6.07	27.6	11.8
9	29	108	60	12.80	3.24	9.56	1.32	8.24	25.3	13.8
10	29	114	63	16.80	4.00	12.80	2.05	10.75	23.8	16.0
11	28	119	65	21.45	4.90	16.55	3.05	13.50	22.8	18.4
12	26	125	68	26.49	5.89	20.60	4.37	16.23	22.2	21.2
13	18	131	70	31.59	6.99	24.60	5.97	18.63	22.1	24.3
14	12	136	71	36.78	8.18	28.60	7.90	20.70	22.2	27.6
15	14	141	72	42.19	9.54	32.65	10.16	22.49	22.6	31.1
16	10	146	73	47.60	10.90	36.70	12.90	23.80	22.9	35.1
17	7	151	74	52.89	12.19	40.70	16.08	24.62	23.0	39.5
18	....	157	75	58.12	13.45	44.67	19.67	25.00	23.1	44.0
19	2	161	76	63.50	14.73	48.77	23.64	25.13	23.2	48.5
20	2	167	77	68.80	15.97	52.83	28.10	24.73	23.2	53.2
21	1	171	78	74.15	17.32	56.83	32.92	23.91	23.4	57.9

Scaling yellow birch logs, Algoma Ecological Section.

Black Ash

Black ash occurs infrequently in the tolerant hardwood stands, and is largely confined to the moist and wet sites. Larger trees of this species are utilized locally as sawlogs.

The total black ash sample of 112 trees was insufficient to show the relationship of cull to D.B.H. and site. On the basis of the available information shown in Table 35, it appears that the average cull is 27 per cent for black ash sawlogs.

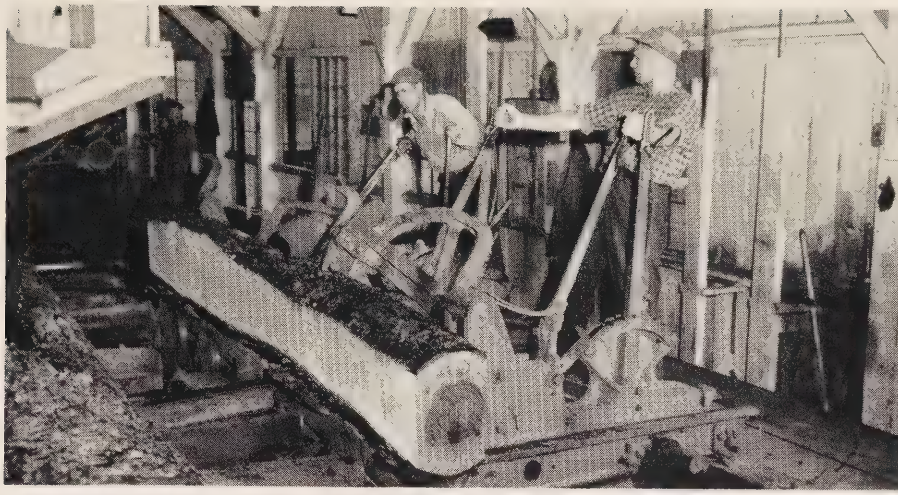
Skidding logs, Algonquin Ecological Section.

Table 35—

Basic Field Data Showing the Sum of Volumes of Trees Sampled, Percentages of Tops, Stumps,

ALL SITES COMBINED—

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet										
				Gross Total	Tops and Stumps	Gross Merchantable			Cull			Net Merchantable		
						Logs	Pulp	Total	Logs	Pulp	Total	Logs	Pulp	Total
4	12	55	51	24.93	21.60	....	3.33	3.33	....	0.17	0.17	....	3.16	3.16
5	17	66	53	52.00	27.48	....	24.52	24.52	....	1.31	1.31	....	23.21	23.21
6	14	68	55	64.06	26.48	....	37.58	37.58	....	1.92	1.92	....	35.66	35.66
7	16	79	59	100.35	32.79	....	67.56	67.56	....	9.29	9.29	....	58.27	58.27
8	6	71	63	53.01	13.98	....	39.03	39.03	....	8.67	8.67	....	30.36	30.36
9	10	96	64	116.65	29.19	....	87.46	87.46	....	17.50	17.50	....	69.96	69.96
10	9	118	67	145.69	30.41	....	115.28	115.28	....	14.61	14.61	....	100.67	100.67
11	6	90	76	111.99	22.86	....	89.13	89.13	....	4.96	4.96	....	84.17	84.17
12	5	122	70	134.10	21.66	....	112.44	112.44	....	12.20	12.20	....	100.24	100.24
13	7	131	72	235.50	36.25	140.92	58.33	199.25	41.43	4.94	46.37	99.49	53.39	152.88
14	1	111	63	30.60	5.64	22.30	2.66	24.96	1.94	....	1.94	20.36	2.66	23.02
15	3	119	78	128.10	17.27	96.59	14.24	110.83	18.88	1.32	20.20	77.71	12.92	90.63
16	1	230	75	62.20	7.26	54.94	....	54.94	9.26	....	9.26	45.68	....	45.68
17	1	187	72	57.00	17.40	31.64	7.96	39.60	3.87	0.45	4.32	27.77	7.51	35.28
18	.	....	...	....	....	....	....	....	....	....	....	....	....	....
19	1	216	74	81.40	18.86	54.10	8.44	62.54	31.11	8.44	39.55	22.99	....	22.99
20	1	223	70	97.50	40.79	56.71	....	56.71	17.03	....	17.03	39.68	....	39.68
21	. .	......	. .	....	....	....	....	....	....	....	....	....	....	....
22	....	......	....	....	....	....	....	....	....	....	....	....	....	....
23	1	214	87	133.60	24.30	106.85	2.45	109.30	14.31	0.61	14.92	92.54	1.84	94.38
24	.	......	....	....	....	....	....	....	....	....	....	....	....	....
25	1	250	79	144.00	25.84	118.16	....	118.16	48.24	....	48.24	69.92	....	69.92
Total	112	......	....	1,772.68	420.06	682.21	670.41	1,352.62	186.07	86.39	272.46	496.14	584.02	1,080.16
Average		......	....	....	....	....	....	....	....	....	....	....	....	....



Mill test, Thessalon, Ontario.

ACK ASH

d Cull for Each Diameter Class, and Conversion Factors from Board Feet to Cubic Feet

GONQUIN ECOLOGICAL SECTION

PERCENTAGE				VOLUME IN BOARD FEET, ONTARIO RULE			PER-CENTAGE	CONVERSION FACTORS FROM BOARD FEET TO CUBIC FEET, GROSS MERCH. VOL.	D.B.H., INCHES
TOPS AND STUMPS IN RELATION TO GROSS TOTAL VOL.	CULL IN RELATION TO GROSS MERCH. VOLUME			GROSS MERCH.	CULL	NET MERCH.	CULL IN REL. TO GROSS MERCH. VOL.		
	LOGS	PULP	AVERAGE	LOGS	LOGS	LOGS	LOGS	LOGS	
86.6	......	5.1	5.1	....	.	...	...	...	4
52.8	......	5.3	5.3	....	....	....	......	......	5
41.3	......	5.1	5.1	....	....	....	......	......	6
32.7	......	13.8	13.8	....	....	....	......	......	7
26.4	......	22.2	22.2	....	....	....	......	......	8
25.0	......	20.0	20.0	....	....	....	......	......	9
20.9	......	12.7	12.7	....	....	....	......	......	10
20.4	......	5.6	5.6	....	....	....	......	......	11
16.2	......	10.9	10.9	....	....	....	......	......	12
15.4	29.4	8.5	23.3	766	248	518	32.4	5.44	13
18.4	8.7	......	7.8	118	14	104	11.9	5.29	14
13.5	19.5	9.3	18.2	525	135	390	25.7	5.44	15
11.7	16.9	......	16.9	340	65	275	19.1	6.19	16
30.5	12.2	5.7	10.9	199	30	169	15.1	6.29	17
......	......	......	......	....	....	....	......	......	18
23.2	57.5	100.0	63.2	318	201	117	63.2	5.88	19
41.8	30.0	......	30.0	356	114	242	32.0	6.28	20
......	......	......	......	....	....	....	......	......	21
......	......	......	......	....	....	....	......	......	22
18.2	13.4	24.9	13.7	679	100	579	14.7	6.35	23
......	......	......	......	....	....	....	......	......	24
17.9	40.8	......	40.8	755	353	402	46.8	6.39	25
......	......	......	......	4,056	1,260	2,796	......	......	TOTAL
23.7	27.3	12.9	20.1	....	....	....	31.1	5.95	AVERAGE

Ironwood

Ironwood is a frequent component of the understory in tolerant hardwood stands in both the Algoma and Algonquin Ecological Sections. It is most commonly found on dry sites of the upper slopes. This species seldom attains merchantable size, and so is of no consequence in sawlog production. It could be utilized for pulpwood in areas where there is a demand for hardwood pulp.

The total sample of ironwood consisted of 157 trees, which were encountered in both the Algonquin and Algoma Sections.

The volumetric relationship of cull to D.B.H. is shown in Table 36. The sample was too small to allow construction of volume and cull percentage graphs, and to analyse the effect of site on cull in ironwood. The average cull calculated from the available sample is 20 per cent.

Table 36—IRONWOOD

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Diameter Class

ALL SITES COMBINED — ALGOMA AND ALGONQUIN ECOLOGICAL SECTIONS

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet					Percentage	
				Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
4	52	52	41	90.80	74.65	16.15	0.52	15.63	82.2	3.2
5	40	71	44	107.12	52.93	54.19	2.83	51.36	49.4	5.2
6	35	87	49	151.89	58.98	92.91	12.14	80.77	38.8	13.1
7	15	112	49	83.49	31.10	52.39	13.49	38.90	37.2	25.7
8	7	107	57	65.49	23.53	41.96	6.70	35.26	35.9	16.0
9	3	138	53	30.43	6.08	24.35	16.55	7.80	20.0	68.0
10	2	95	60	27.68	8.00	19.68	5.12	14.56	28.9	26.0
11	2	103	62	39.00	8.46	30.54	10.05	20.49	21.7	32.9
12	......	......	....	....	....	....	....	....	......	......
13	......	......	....	....	....	....	....	....	......	......
14	1	121	49	27.60	5.02	22.58	5.16	17.42	18.2	22.9
Total	157	......	....	623.50	268.75	354.75	72.56	282.19	......	......
Average	......	......	....	....	....	....	....	....	43.1	20.5

White Cedar

White cedar is commonly found in both the Algoma and Algonquin Ecological Sections, although its occurrence is largely limited to moist and wet sites.

Utilization of this species is very sporadic and local in character. The most common product obtained from white cedar is posts for fencing purposes. The total sample of white cedar was 116 trees, which were cut in both the Algoma and Algonquin Ecological Sections.

Table 37 shows the volumetric relationship of cull to D.B.H., for the total sample. This sample, however, is too small to allow the construction of volume and cull percentage graphs. The average cull for the available sample is 35 per cent.

White Spruce

White spruce occurs in both the Algoma and Algonquin Ecological Sections as a scattered component of the tolerant hardwood stands of sugar maple and yellow birch. It often attains a large size in both height and diameter and is, therefore, utilized mostly for logs.

The total sample of white spruce encountered in both ecological sections was only 83 trees; Table 38 shows the volumetric relationship of cull to age for this species. The average cull of approximately 5 per cent may not be reliable because of the relatively small number of trees sampled. This applies particularly to the overmature white spruce trees, which are often encountered in both the Algoma and Algonquin Sections.

Table 37—WHITE CEDAR

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Diameter Class

ALL SITES COMBINED — ALGOMA AND ALGONQUIN ECOLOGICAL SECTIONS

D.B.H., Inches	No. of Sample Trees	Average Age, Years	Average Height, Feet	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
4	19	49	30	26.16	21.95	4.21	....	4.21	83.9	......
5	15	68	31	29.67	16.25	13.42	1.78	11.64	54.8	13.3
6	19	74	35	61.54	24.06	37.48	3.87	33.61	39.1	10.3
7	11	102	45	55.62	21.13	34.49	10.68	23.81	38.0	31.0
8	15	87	39	92.89	25.15	67.74	2.44	65.30	27.1	3.6
9	15	105	43	124.88	30.47	94.41	19.60	74.81	24.4	20.8
10	6	148	51	71.08	14.12	56.96	28.61	28.35	19.9	50.2
11	2	91	44	26.00	6.65	19.35	1.71	17.64	25.6	8.8
12	2	138	52	30.90	6.18	24.72	11.25	13.47	20.0	45.5
13	4	205	56	88.20	14.46	73.74	34.88	38.86	16.4	47.3
14	2	108	52	42.00	7.57	34.43	17.29	17.14	18.0	50.2
15	..	.. ...	....	....	.. . .	. . ..	. .	....	.. . .	......
16	2	225	60	54.60	10.23	44.37	29.25	15.12	18.7	65.9
17	1	200	66	33.40	6.99	26.41	10.07	16.34	20.9	38.1
18	.	. . .	. .	.... ..	.....	. . .	.. .. ..	. . ..	.. .	. .
19	2	265	64	84.30	14.26	70.04	42.64	27.40	16.9	60.9
20	1	252	70	52.20	9.44	42.76	11.58	31.18	18.1	27.1
Total	116	......	....	873.44	228.91	644.53	225.65	418.88	.	. ..
Average	. . .		. .	. . .	. . ..	.		. . . .	26.2	35.0

Table 38—WHITE SPRUCE

Basic Field Data Showing the Sum of Volumes of Trees Sampled and Percentages of Tops, Stumps, and Cull for Each Age Class

ALL SITES COMBINED — ALGOMA AND ALGONQUIN ECOLOGICAL SECTIONS

Age Class, Years	No. of Sample Trees	Average Age, Years	Average Height, Feet	Average D.B.H., Inches	Volume in Cubic Feet: Gross Total	Tops and Stumps	Gross Merch.	Cull	Net Merch.	Percentage: Tops and Stumps in Relation to Gross Total Volume	Cull in Relation to Gross Merch. Volume
21–40	1	40	28	5.0	2.13	1.04	1.09	....	1.09	48.8	. .
41–60	23	49	39	6.3	112.47	32.75	79.72	1.85	77.87	29.1	2.3
61–80	8	69	34	5.7	38.51	7.41	31.10	0.65	30.45	19.2	2.1
81–100	12	91	46	7.4	114.28	20.17	94.11	11.06	83.05	17.6	11.8
101–120	17	112	64	11.8	503.29	58.16	445.13	28.21	416.92	11.6	6.3
121–140	14	128	53	8.8	209.51	32.80	176.71	11.59	165.12	15.7	6.6
141–160	2	145	65	11.6	41.60	4.71	36.89	....	36.89	11.3	......
161 +	6	193	82	15.2	295.08	30.40	264.68	3.92	260.76	10.3	1.5
Total	83	......	....	......	1,316.87	187.44	1,129.43	57.28	1,072.15	......	
Average	....	......	....	......	....	....	....	....	....	14.2	5.1

Some Aspects of Tolerant Hardwood Management to Reduce Cull Losses

The wide application of sound silvicultural methods in harvesting tolerant hardwood stands, to be economically feasible, is largely dependent on the demand for marginal material, suitable only for low-grade lumber, pulpwood, charcoal, or firewood. Since the demand for this material in Ontario is at present very limited, the current logging practice in tolerant hardwood stands still consists largely of selecting the premium species and better-quality individual stems. This practice generally leads to a degraded forest because it tends to build up the quantities of cull material and off-site species. In order to avoid this serious accumulation of stands of low productivity and the high losses in merchantable volume caused by cull, which are characteristic of such stands, it will be necessary to expand substantially the silvicultural programme which has recently been initiated.

In Ontario there are three general forest conditions with which to work, namely, mature virgin stands, immature stands, and cut-over stands. In several localities, particularly in Algoma, there are large areas in which the hardwoods have never been cut. In the normal process of making a commercial cut in these stands, the defective and wolf trees should also be cut down and provisions made for the regeneration of desirable species, which are usually yellow birch on the fresh and moist sites, and white pine or white spruce on the drier sites.

Immature stands are usually the result of burns or heavy cut-over. Future cull losses in these stands can be avoided by encouraging the development of healthy, vigorous trees of the desired species. Wolf and defective trees should be removed and the best individuals freed from excessive competition.

From the economic standpoint, the most difficult conditions to correct are those occurring in stands that have been severely highgraded by successive cuts over a number of years. These stands are usually made up of unmerchantable material, with little chance of a financial return until the following rotation. Therefore, the removal of these highly defective stands and provision for suitable regeneration represent a capital investment.

A start has now been made by the Province of Ontario to deal with the problem of tolerant hardwood management. A special effort is being made to obtain yellow birch regeneration in the course of regular woods operations, and degraded stands are being converted to young, healthy, vigorous stands through a forest improvement programme in areas where such a programme is economically feasible.

Tree Decadence Classification

The tree decadence classification was introduced for the purpose of investigating the possibility of obtaining a reliable method for estimating cull in standing tolerant hardwood trees, based on the interpretation of visible signs of defects. It was hoped that this method, when incorporated in the inventory or operational cruise, would provide a basis for calculating net merchantable volumes for specific areas.

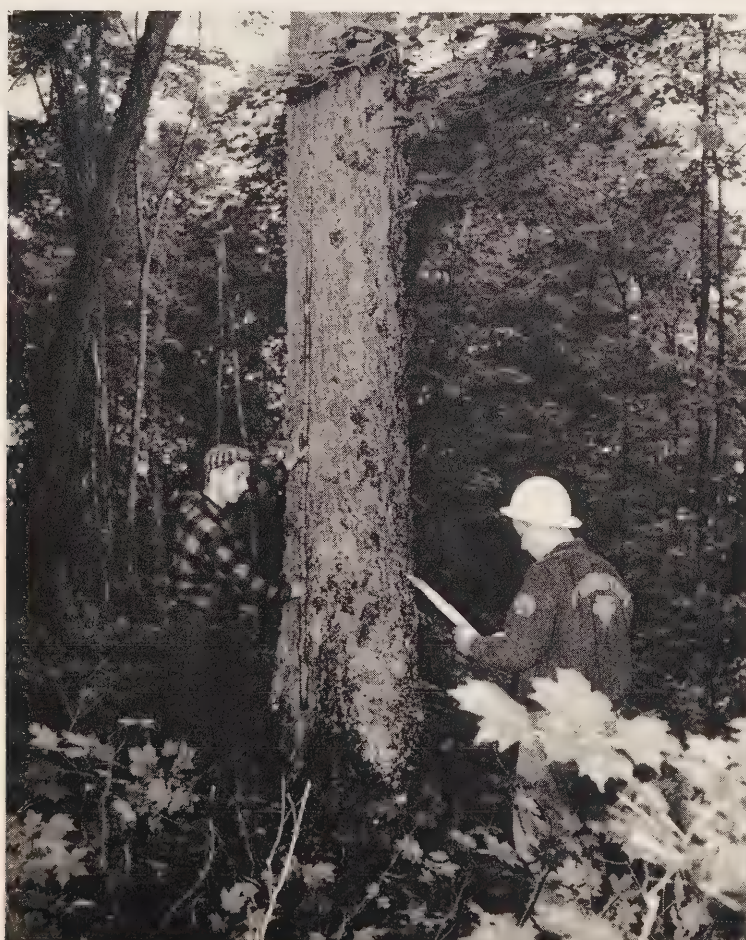
Consequently, in the course of the cull surveys, the standing tolerant hardwood trees from 13 inches D.B.H. up were classified in four groups, based on the visible defects as outlined in Table 43, Appendix A. An approximate estimate of the percentage of cull that might be expected in these classes is given in Table 44, Appendix A. Summaries of the percentages of cull arrived at through scaling procedure were made for the trees in the different classes and compared with the estimated percentages of cull derived from this method.

The results by species compared in Table 39 show that while the differences for some species in individual management units had a range from +17 per cent to −11 per cent, the average difference for the sample of 2,232 trees for five different species was only 1.3 per cent. This result appears to be sufficiently encouraging to warrant the recommendation of adopting the tree decadence classification as a regular part of cruising procedure in tolerant hardwoods. However, it should be emphasized that in order to obtain satisfactory results in the practical application of this method, at least several hundred trees should be sampled, and only personnel with scaling and operating experience in tolerant hardwoods should be used.

Table 39

Comparison of Cull Percentage Estimated in Standing Tolerant Hardwood Trees by Using the Tree Decadence Classification, and of Cull Percentage Calculated by Scaling

Species	No. of Trees Sampled 13″ D.B.H. Up	Percentage of Cull		Difference		
		Estimated by Tree Decadence Classification	Calculated by Scaling	Average Underestimate	Average Overestimate	Range
Sugar maple	1,189	36.1	30.4	...	5.7	+17.1 to − 2.0
Yellow birch	894	39.1	42.3	3.2		+12.2 to −10.9
Basswood	66	22.8	23.1	0.3		......
Beech	66	38.3	34.8	.	3.5	......
Black ash	17	31.3	27.3		4.0	......
Weighted Average	2,232	37.0	35.7		1.3	......



Estimating cull in standing yellow birch tree, Algoma Ecological Section.

Log Grading and Mill Tests

During the course of the cull surveys in tolerant hardwoods, four sawmill tests were conducted in co-operation with sawmill operators and with the Forest Products Laboratory, Forestry Branch, Canada Department of Northern Affairs and National Resources, Ottawa.

The purpose of these tests was to investigate and determine the applicability of the hardwood log grading specifications adopted in this project. The results obtained during the cull surveys, shown in Table 40 for sugar maple and in Table 41 for yellow birch, are compared in Table 42 to the results arrived at during similar studies carried out on a larger scale by the Forest Products Laboratories in Madison, Wisconsin, U.S.A. (17), and in Ottawa, Ontario (3).

A satisfactory log grading system should show progressively lower percentages of number 1 common and better lumber in the poorer grades of logs. While this result is evident in the case of the studies at Madison and at Ottawa, the cull survey data show too high a proportion of No. 1 common and better lumber for log grades 2 and 3.

This would suggest that the log grading system used by both Forest Products Laboratories at Madison and at Ottawa is more suitable for grading tolerant hardwood logs than are the specifications used in this project.

It should, however, be pointed out that these latter specifications gave reasonably satisfactory results in a study on mixed-oak farmwoods in Wisconsin (7). The percentage of No. 1 common and better lumber obtained during the above study shows the progressively lower values for log grades 2 and 3, as would be expected. It is likely that the unusually high recovery of No. 1 common and better lumber in this project for log grades 2 and 3, was the result of the tendency on the part of field personnel to underestimate the quality of these logs. Consequently, a number of better logs classified as grade 2 should have been classified as grade 1, and a number of logs classified as grade 3 were in fact of grade 2 quality.

It is therefore apparent that in order to achieve satisfactory results in this type of work, only personnel experienced in log grading should be used.

The mill tests have also served as a check on the reliability of deductions for cull made through the scaling of tolerant hardwood logs. The comparison of net merchantable board-foot volume derived through the scaling of logs, and the total mill recovery from those logs has shown that for sugar maple there was no practical difference, but for yellow birch the average mill over-run was 23 per cent. In all probability this over-run in yellow birch resulted from considering much of the "brown heart" as cull (13), whereas in fact it produced some usable lumber of lower quality.

Table 40—SUGAR MAPLE

Summary of Sawmill Recovery by Log Grades

Combined Results of Four Mill Tests

(BASIS — 285 LOGS)

Log Grade		Lumber Grade Yields								Total of All Grades
		No. 1 Common and Better				2 and 3 Common				
		FAS	SEL	1C	Total	2C	3A	3B	Total	
1	Volume, bd. ft.	239	189	156	584	102	76	193	371	955
	Per cent	25.0	19.8	16.3	61.1	10.7	8.0	20.2	38.9	100.0
2	Volume, bd. ft.	678	1,244	1,801	3,723	1,096	954	1,403	3,453	7,176
	Per cent	9.5	17.3	25.1	51.9	15.3	13.3	19.5	48.1	100.0
3	Volume, bd. ft.	188	499	1,194	1,881	1,226	1,048	1,315	3,589	5,470
	Per cent	3.5	9.1	21.8	34.4	22.4	19.2	24.0	65.6	100.0
Total	Volume, bd. ft.	1,105	1,932	3,151	6,188	2,424	2,078	2,911	7,413	13,601
	Per cent	8.1	14.2	23.2	45.5	17.8	15.3	21.4	54.5	100.0

Table 41—YELLOW BIRCH

Summary of Sawmill Recovery by Log Grades

Combined Results of Four Mill Tests

(BASIS — 317 LOGS)

Log Grade		Lumber Grade Yields: No. 1 Common and Better: FAS	SEL	1C	Total	2 and 3 Common: 2C	3A	3B	Total	Total of All Grades
1	Volume, bd. ft.	2,031	1,019	999	4,049	765	465	172	1,402	5,451
	Per cent	37.3	18.7	18.3	74.3	14.0	8.5	3.2	25.7	100.0
2	Volume, bd. ft.	1,724	1,950	2,431	6,105	1,744	1,586	1,096	4,426	10,531
	Per cent	16.4	18.5	23.1	58.0	16.5	15.1	10.4	42.0	100.0
3	Volume, bd. ft.	1,204	1,317	1,814	4,335	1,424	1,113	1,052	3,589	7,924
	Per cent	15.2	16.6	22.9	54.7	18.0	14.0	13.3	45.3	100.0
Total	Volume, bd. ft.	4,959	4,286	5,244	14,489	3,933	3,164	2,320	9,417	23,906
	Per cent	20.8	17.9	21.9	60.6	16.5	13.2	9.7	39.4	100.0

Table 42

Comparison of Yields, No. 1 Common and Better Lumber, by Species and Log Grades

Species	Per cent of No. 1 Common and Better Lumber[1] in Logs Graded as Shown: Log Grade 1: F.P.L.[2] Madison	F.P.L.[3] Ottawa	Cull Survey	Log Grade 2: F.P.L.[2] Madison	F.P.L.[3] Ottawa	Cull Survey	Log Grade 3: F.P.L.[2] Madison	F.P.L.[3] Ottawa	Cull Survey
Sugar maple	68.2	70.4	61.1	40.9	48.3	51.9	15.2	23.7	34.4
Yellow birch	70.3	74.3	74.3	42.5	50.7	58.0	13.2	22.6	54.7

[1] The columns consist of the actual yields of FAS, Selects, and No. 1 Common.

[2] Forest Products Laboratory, Madison, Wisconsin (16).

[3] From the interim report of the Forest Products Laboratories, Canada Department of Northern Affairs and National Resources, Forestry Branch, Project 0-217, Ottawa, February, 1958.

Mill test — grading lumber.

SUMMARY AND CONCLUSIONS

● 1. The purpose of the survey was to determine cull factors for the main commercial tree species in Ontario, excluding white and red pine, so that more accurate inventories of commercial volumes could be produced; and, as far as possible, to relate the cull factors to age and site in order to give them a wider application in forest management.

2. The field data were segregated on a broad ecological basis by forest regions and ecological sections, in order to retain these variables where necessary.

3. It is obvious that the reliability of results will depend on the degree to which all field conditions are sampled. In a province-wide survey of this nature, it is inevitable that many sampling deficiencies will exist, which will become most evident when results are applied on a local basis. For this reason, when accurate cull factors are required for specific local areas, it may be necessary to supplement the existing information with additional field work.

Sampling of black spruce, jack pine, aspen, sugar maple, and yellow birch was adequate to give a fairly good indication of the relation of cull to both age and site.

Several species, namely, balsam fir, white birch, beech, and hemlock were sampled in sufficient numbers to obtain a reasonably reliable indication of the influence of tree age on cull, but sampling was insufficient to analyse for site. The cull relationships of balsam fir should be studied further, in view of the probable future importance of this species in the forest economy.

The sample of the remaining species studied, namely, white spruce, white elm, black ash, basswood, black cherry, red oak, ironwood, red maple, and white cedar, was not adequate to analyse for the effect of either age or site. The actual sample and average cull factor for some of these species are included in the report, but should be used with reservation. The sample of all these species was small because they were taken as they were encountered in stands of other species. White spruce in particular should be further investigated.

4. The results obtained for the species under investigation indicate that the age of individual trees and of stands is the primary factor determining the degree of cull and the resulting losses of merchantable volume. Decay, which causes cull, develops progressively with age; losses of merchantable volume are insignificant in immature stands and generally increase when stands become older. Therefore, it is apparent that age should be taken into consideration when using cull factors in management planning, and that the use of general average cull factors can lead to serious errors in estimating net merchantable volumes in specific areas.

In most species, the increase of cull with age was quite consistent. It is evident, however, that a large sample is needed to provide reliable results. It is also obvious that a supplementary analysis of cull in relation to tree size, as expressed by D.B.H. classes, is necessary for easy application in management work, such as tree marking. This is particularly necessary for those species whose age is difficult to determine in the field. It was found that the degree of cull generally increased with diameter in much the same way as with age, and in some species the correlation between cull and tree diameter was quite strong.

5. In general, the soil moisture appeared to have a much greater effect on cull in conifers, especially black spruce and jack pine, than in hardwoods. In jack pine cull was lowest on the better, fresh sites, and in black spruce the lowest cull occurred on the poor, wet sites. The latter sites are generally cold with impaired drainage, and probably inhibit the development of wood-destroying fungi. Although cull in black spruce was relatively high on the fresh and moist sites, the higher volume per tree on these sites more than compensated for the losses through cull.

In the case of hardwood trees, where no positive conclusions could be reached on the effect of soil moisture on cull, it is possible that other factors, particularly disturbances and changes to the stands caused by past logging operations, have had an effect on the degree of cull in residual trees.

As was pointed out previously, the analysis of the influence of site on cull presented considerable difficulty. Because of the large number of factors involved, it would be necessary in any future study to narrow the scope of the investigation to fewer tree species, and thereby greatly increase the sampling for any one species. This would permit a greater

control of variables and a more thorough analysis of the important factors.

6. The tree decadence classification used in this survey, through which an estimation of cull is made in standing tolerant hardwood trees, proved to be sufficiently close to the scaled volumes to permit its use in inventory field procedure. Qualified personnel are a prerequisite for its successful application.

7. Several mill tests were conducted to test the applicability of the hardwood log-grading specifications adopted in this project. In the case of grade 1 logs the results were satisfactory, but in the case of grade 2 and especially grade 3 logs the results were too conservative, in that these grades produced an unexpectedly high proportion of No. 1 common and better lumber. This, however, is not likely to be the result of faulty specifications as much as an underestimation by field personnel of the quality of logs classified as grades 2 and 3.

8. The methods adopted in the survey have proved satisfactory in dealing with the objectives of this project. The sample plots were chosen selectively, although random sampling might have provided more representative volume data. However, to carry out a province-wide survey of the effects of age and site on cull factors of several species within a limited time, it was felt that an adequate number of trees could be sampled only if plots were chosen in stands of average or, in some cases, above-average densities.

It should be emphasized that the calculations included in the report are based on measurements of single trees taken from stands of varying composition and densities. Hence the volumes for each age class shown in graphs and tables cannot be expected to give representative stand volume data on an area basis.

In any future more detailed study, improvements would be necessary with respect to site factors and determination of ages of certain hardwood species.

9. It is believed that the results of this survey will constitute a useful supplement to the provincial inventory, and will prove helpful in management planning and in field work. Inventory data are given in gross total volumes, which then must be converted to gross and net merchantable volumes by taking into account the unmerchantable portions of trees contained in tops, stumps, and cull. Data presented in this report for the main commercial tree species sampled should permit more accurate estimates of gross and net merchantable volumes for specific ages or diameters, and in the case of black spruce and jack pine, also for different site conditions.

General view of sawmill, Thessalon, Ontario.

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APPENDIX A

Specifications Used in Tree Decadence Classification

Table 43

Location and Extent of Visible Defects in Standing Tolerant Hardwood Trees

Defect	Tree Decadence Classes			
	A	B	C	D
Dead limb	Small, less than 6 inch diam.	Large, over 6 inch diam.	Large, over 6 inch diam.	Highly defective, cull trees
Conk	None	Active, above butt log	Active in butt log	
Top	Sound	Broken or dead	Broken or dead	
Crack	Small, open, anywhere (less than ⅓ of log affected)	Large, open, above butt log (at least ⅓ of log affected)	Large, open, in butt log (at least ⅓ of log affected)	
Crook or sweep	Slight above butt log (up to 10 per cent of log lost)	Moderate above butt log (up to ⅓ of log lost), slight in butt log	Excessive above butt log (⅓ to ⅔ of log lost), moderate in butt log	
Hole or cavity	Small, above butt log (less than ⅓ of log affected)	Large, above butt log (at least ⅓ of log affected)	Large, in butt log (at least ⅓ of log affected)	
Ingrown bark	Anywhere	Anywhere	Anywhere	
Rotten burl	None	Large, anywhere	Large, anywhere	
Scar	Small, above butt log (up to 10 per cent of log affected)	Large, anywhere (at least ¼ of log affected)	Large, anywhere (at least ¼ of log affected)	
Seam	Small, straight, less than 6 feet long, anywhere	Large, straight, 6 feet long and more, anywhere	Spiral, anywhere	

NOTE — The effect on tree quality of each defect listed above may vary from one locality to another. Therefore the contents of this Table should be used as a guide to interpret local conditions, rather than a general rule.

Table 44

Tree Decadence Classification of Standing Tolerant Hardwood Trees

Class	Estimated Range of Per Cent Cull*	Group Average Per Cent Cull	Specifications
A	Below 10	......	Sound trees likely to yield one or more Grade 1 logs (veneer), or thrifty potential veneer log trees.
B	From 10 to 33⅓	25	Trees with some defects, but likely to yield one or more Grade 2 sawlogs.
C	Over 33⅓ to 66⅔	50	Defective trees, but suitable for Grade 3 sawlogs.
D	Over 66⅔	100	Highly defective, cull trees.

* Based on local interpretation of defects listed in Table 43.

APPENDIX B

Types of Decay and Associated Specific Fungi for Some Tree Species

Table 45—BLACK SPRUCE

Occurrence of Different Types and Stages of Decay and Their Location

TOTAL NUMBER OF TREES 6,269
TOTAL MERCH. VOLUME (COMPUTED) .... 24,045.52 CU. FT.
TOTAL DECAY VOLUME (COMPUTED) .... 501.19 CU. FT.

Type of Decay	Volume (Cu. Ft.)	Per Cent of Total Decay Volume
1. Red pocket rot		
trunk	23.65	
trunk-butt	64.40	
butt	61.43	
Total	149.48	29.8
2. Incipient red rot		
trunk	86.67	
trunk-butt	39.92	
butt	50.20	
Total	176.79	35.3
3. Yellow stringy rot		
trunk	16.59	
trunk-butt	42.49	
butt	95.26	
Total	154.34	30.8
4. Brown cubical rot		
trunk	2.38	
butt	18.20	
Total	20.58	4.1
GRAND TOTAL	501.19	100.0
Butt rot	261.68	52.2
Trunk rot	239.51	47.8
Total	501.19	100.0
Incipient rot	176.79	35.3
Advanced rot	324.40	64.7
Total	501.19	100.0

Table 46—BLACK SPRUCE

Occurrence of Different Fungi and Their Association with Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation: Trunk	Trunk-butt	Butt	Total	Per Cent of Identified Isolations
1. Red pocket rot					
Fomes pini	5	19	26	50	51.0
Polyporus circinatus	....	..	32	32	32.6
Corticium galactinum	....	....	5	5	5.1
Merulius himantioides	....	....	3	3	3.1
Peniophora septentrionalis	....	....	3	3	3.1
Stereum sanguinolentum	....	1	......	1	1.0
Sterile	2	....	2	4	4.1
Total	7	20	71	98	100.0
2. Incipient red rot					
Fomes pini	26	17	45	88	41.9
Polyporus circinatus	....	....	57	57	27.1
Peniophora septentrionalis	9	2	20	31	14.7
Stereum sanguinolentum	8	1	9	18	8.6
Corticium galactinum	....	....	5	5	2.4
Odontia bicolor			1	1	.5
Peniophora gigantea	....	....	1	1	.5
Fomes subroseus	1	.	..	1	.5
Sterile	....	....	8	8	3.8
Total	44	20	146	210	100.0
3. Yellow stringy rot					
Corticium galactinum	....	....	65	65	41.7
Poria subacida	....	....	18	18	11.6
Omphalia campanella	....	....	13	13	8.3
Odontia bicolor	....	1	12	13	8.3
Peniophora septentrionalis	....	....	6	6	3.9
Flammula connisans	....	....	5	5	3.2
Fomes pini	....	....	4	4	2.6
Polyporus circinatus	....	....	2	2	1.3
Fomes subroseus	....	....	2	2	1.3
Polyporus abietinus	....	....	2	2	1.3
Armillaria mellea	....	....	2	2	1.3
Peniophora aspera	....	....	2	2	1.3
Polyporus volvatus	....	....	1	1	.6
Trechispora brinkmanni	....	....	1	1	.6
Stereum sanguinolentum	....	....	1	1	.6
Merulius himantioides	....	....	1	1	.6
Stereum chailletii	....	....	1	1	.6
Sterile	....	....	17	17	10.9
Total	....	1	155	156	100.0
4. Brown cubical rot					
Coniophora puteana	....	....	25	25	52.0
Merulius himantioides	....	....	15	15	31.2
Fomes subroseus	....	....	3	3	6.3
Polyporus balsameus	....	....	3	3	6.3
Polyporus schweinitzii	....	....	1	1	2.1
Sterile	....	....	1	1	2.1
Total	....	....	48	48	100.0

Table 47—WHITE SPRUCE[1]

Occurrence of Different Types and Stages of Decay and Their Location

TOTAL NUMBER OF TREES.. 481
TOTAL MERCH. VOLUME (COMPUTED).......................... 4,200.47 CU. FT.
TOTAL DECAY VOLUME (COMPUTED)............................ 115.98 CU. FT.

Type of Decay	Volume (Cu. Ft.)	Per Cent of Total Decay Volume
1. Red pocket rot		
trunk	2.27	....
trunk-butt	32.13	....
butt	15.55	....
Total	49.95	43.1
2. Incipient red rot		
trunk	12.79	....
trunk-butt	9.11	....
butt	4.91	....
Total	26.81	23.1
3. Yellow stringy rot		
trunk	3.78	....
trunk-butt	4.75	....
butt	25.20	....
Total	33.73	29.1
4. Brown cubical rot		
butt	5.49	....
Total	5.49	4.7
GRAND TOTAL	115.98	100.0
Butt rot	62.61	54.0
Trunk rot	53.37	46.0
Total	115.98	100.0
Incipient rot	26.81	23.1
Advanced rot	89.17	76.9
Total	115.98	100.0

[1] This table includes trees sampled in the Boreal Forest Region only.

Table 48—WHITE SPRUCE[1]

Occurrence of Different Fungi and Their Association with Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
1. Red pocket rot					
Polyporus circinatus	....	....	7	7	53.8
Fomes pini	....	3	1	4	30.8
Omphalia campanella	....	....	1	1	7.7
Sterile	1	....	...	1	7.7
Total	1	3	9	13	100.0
2. Incipient red rot					
Poria subacida	2	....	....	2	28.5
Stereum sanguinolentum	1	....	....	1	14.3
Stereum chailletii	1	....	....	1	14.3
Fomes pini	....	....	1	1	14.3
Polyporus circinatus	....	....	1	1	14.3
Sterile	.	....	1	1	14.3
Total	4	....	3	7	100.0
3. Yellow stringy rot					
Corticium galactinum	....	....	19	19	67.8
Odontia bicolor	....	....	3	3	10.7
Poria subacida	....	....	2	2	7.1
Polyporus circinatus	....	....	1	1	3.6
Polyporus volvatus	....	....	1	1	3.6
Fomes subroseus	1	....	....	1	3.6
Sterile	....	....	1	1	3.6
Total	1	....	27	28	100.0
4. Brown cubical rot					
Polyporus schweinitzii	....	....	1	1	25.0
Peniophora septentrionalis	....	....	1	1	25.0
Coniophora puteana	....	....	1	1	25.0
Polyporus balsameus	....	....	1	1	25.0
Total	...	....	4	4	100.0

[1] This table includes trees sampled in the Boreal Forest Region only.

Table 49—JACK PINE

Occurrence of Different Types and Stages of Decay and Their Location

TOTAL NUMBER OF TREES........ 4,287

TOTAL MERCH. VOLUME (COMPUTED)........ 46,550.71 CU. FT.

TOTAL DECAY VOLUME (COMPUTED) .... 3,442.61 CU. FT.

Type of Decay	Volume (Cu. Ft.)	Per Cent of Total Decay Volume
1. Red pocket rot		
trunk	698.31	....
trunk-butt	988.50	....
butt	70.69	....
Total	1,757.50	51.1
2. Incipient red rot		
trunk	850.39	....
trunk-butt	646.52	....
butt	104.36	....
Total	1,601.27	46.5
3. Yellow stringy rot		
trunk	3.11	....
trunk-butt	.41	....
butt	11.84	....
Total	15.36	0.4
4. Brown cubical rot		
trunk	.23	..
trunk-butt	6.97	....
butt	61.28	....
Total	68.48	2.0
GRAND TOTAL	3,442.61	100.0
Butt rot	658.86	19.1
Trunk rot	2,783.75	80.9
Total	3,442.61	100.0
Incipient rot	1,601.27	46.5
Advanced rot	1,841.34	53.5
Total	3,442.61	100.0

Table 50—JACK PINE

Occurrence of Different Fungi and Their Association with Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
1. Red pocket rot					
Fomes pini	105	146	102	353	88.7
Polyporus circinatus	......	1	12	13	3.3
Corticium galactinum	......	2	5	7	1.8
Fomes subroseus	4	1	1	6	1.5
Stereum pini	......	......	2	2	.5
Poria asiatica	......	1	1	2	.5
Omphalia campanella	......	2	......	2	.5
Peniophora gigantea	2	......	......	2	.5
Sterile	6	......	5	11	2.7
Total	117	153	128	398	100.0
2. Incipient red rot					
Fomes pini	388	203	245	836	70.2
Stereum pini	210	37	37	284	23.8
Polyporus circinatus	1	......	28	29	2.4
Fomes subroseus	2	2	......	4	.3
Corticium galactinum	......	1	1	2	.2
Merulius himantioides	......	......	1	1	.1
Omphalia campanella	1	......	......	1	.1
Peniophora gigantea	1	......	......	1	.1
Corticium fuscostratum	1	......	......	1	.1
Flammula connisans	......	......	1	1	.1
Stereum sanguinolentum	......	......	1	1	.1
Sterile	9	5	16	30	2.5
Total	613	248	330	1,191	100.0
3. Yellow stringy rot					
Corticium galactinum	......	......	20	20	71.5
Poria subacida	......	......	3	3	10.7
Omphalia campanella	......	......	2	2	7.1
Poria asiatica	1	......	1	2	7.1
Merulius himantioides	......	......	1	1	3.6
Total	1	......	27	28	100.0
4. Brown cubical rot					
Merulius himantioides	......	......	13	13	29.0
Poria asiatica	......	1	10	11	24.5
Coniophora puteana	......	......	7	7	15.6
Polyporus schweinitzii	......	......	4	4	8.9
Corticium fuscostratum	......	......	2	2	4.4
Poria monticola	......	......	2	2	4.4
Peniophora gigantea	......	......	1	1	2.2
Omphalia campanella	......	......	1	1	2.2
Fomes subroseus	......	......	1	1	2.2
Fomes pini	......	......	1	1	2.2
Sterile	......	......	2	2	4.4
Total	......	1	44	45	100.0

Table 51—BALSAM FIR [1]

Occurrence of Different Types and Stages of Decay and Their Location

TOTAL NUMBER OF TREES 1,139
TOTAL MERCH. VOLUME (COMPUTED) ..... 4,626.56 CU. FT.
TOTAL DECAY VOLUME (COMPUTED) ..... 392.51 CU. FT.

Type of Decay	Volume (Cu. Ft.)	Per Cent of Total Decay Volume
1. Red heart rot		
trunk	261.20	....
trunk-butt	56.18	....
butt	4.11	....
Total	321.49	81.9
2. Yellow stringy rot		
trunk	.63	....
trunk-butt	1.83	....
butt	59.61	....
Total	62.07	15.8
3. Brown cubical rot		
butt	8.95	....
Total	8.95	2.3
GRAND TOTAL	392.51	100.0
Butt rot	87.07	22.2
Trunk rot	305.44	77.8
Total	392.51	100.0

[1] This table includes only those trees sampled in the Boreal Forest Region.

Table 52—BALSAM FIR [1]

Occurrence of Different Fungi and Their Association with Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
1. Red heart rot					
Stereum sanguinolentum	114	12	4	130	84.3
Corticium galactinum	3	....	1	4	2.5
Trechispora brinkmanni	1	....	......	1	.7
Stereum chailletii	......	1	......	1	.7
Stereum murraii	......	....	1	1	.7
Poria odora	1	....	......	1	.7
Peniophora gigantea	1	....	......	1	.7
Peniophora septentrionalis	1	....	......	1	.7
Stereum purpureum	1	....	......	1	.7
Sterile	13	....	......	13	8.3
Total	135	13	6	154	100.0
2. Yellow stringy rot					
Corticium galactinum	......	....	48	48	34.8
Odontia bicolor	......	....	45	45	32.6
Armillaria mellea	......	....	15	15	10.9
Poria subacida	......	....	9	9	6.6
Stereum sanguinolentum	......	....	3	3	2.2
Polyporus circinatus	......	....	2	2	1.4
Omphalia campanella	......	....	1	1	.7
Polyporus adustus	......	....	1	1	.7
Polyporus anceps	......	....	1	1	.7
Stereum chailletii	......	....	1	1	.7
Sterile	2	1	9	12	8.7
Total	2	1	135	138	100.0
3. Brown cubical rot					
Coniophora puteana	......	....	9	9	40.9
Merulius himantioides	......	....	9	9	40.9
Polyporus balsameus	......	....	4	4	18.2
Total	......	....	22	22	100.0

[1] This table includes only those trees sampled in the Boreal Forest Region.

Table 53—ASPEN [1]

Occurrence of Different Types of Decay and Stain and Their Location

TOTAL NUMBER OF TREES ... 2,343
TOTAL MERCH. VOLUME (COMPUTED) ... 35,756.74 CU. FT.
TOTAL DECAY AND STAIN VOLUME (COMPUTED) ... 9,807.19 CU. FT.

Type of Decay or Stain	Volume (Cu. Ft.)	Per Cent of Total Decay and Stain Volume
1. White punky rot		
trunk	1,357.43	
trunk-butt	452.34	
butt	4.88	
Total	1,814.65	18.5
2. Yellow stringy rot		
trunk	827.51	
trunk-butt	424.43	
butt	123.47	
Total	1,375.41	14.0
3. Mottled stain		
all	663.40	
Total	663.40	6.8
4. Brown stain		
all	5,953.73	
Total	5,953.73	60.7
GRAND TOTAL	9,807.19	100.0
Total stain	6,617.13	67.5
Total rot	3,190.06	32.5
Total	9,807.19	100.0
Butt rot	346.95	10.9
Trunk rot	2,843.11	89.1
Total	3,190.06	100.0

[1] This table includes only those trees sampled in the Boreal Forest Region.

Table 54—ASPEN[1]

Occurrence of Different Fungi and Their Association with Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
1. White punky rot					
Fomes igniarius var. populinus	233	63	8	304	75.8
Corticium polygonium	12	5	2	19	4.7
Polyporus adustus	11	1	......	12	2.9
Radulum casearium	8	1	1	10	2.5
Stereum purpureum	8	......	......	8	2.0
Gleocystidium karstenii	7	......	......	7	1.7
Fomes conchatus	6	......	......	6	1.4
Phlebia strigoso-zonata	4	......	......	4	1.0
Polyporus dryophilus	3	......	......	3	.7
Peniophora cinerea	2	......	......	2	.5
Trechispora brinkmanni	1	......	......	1	.3
Polyporus zonatus	1	......	......	1	.3
Polyporus tulipiferae	1	......	......	1	.3
Pleurotus subareolatus	1	......	......	1	.3
Collybia velutipes	1	......	......	1	.3
Armillaria mellea	......	1	......	1	.3
Sterile	13	6	1	20	5.0
Total	312	77	12	401	100.0
2. Yellow stringy rot					
Radulum casearium	202	73	41	316	43.7
Corticium polygonium	111	15	10	136	18.8
Pholiota spectabilis	2	2	31	35	4.8
Armillaria mellea	......	1	18	19	2.6
Gleocystidium karstenii	12	......	7	19	2.6
Pholiota adiposa	2	3	12	17	2.4
Polyporus adustus	7	1	9	17	2.4
Polyporus dryophilus	12	2	2	16	2.2
Pleurotus subareolatus	5	2	3	10	1.4
Polyporus tulipiferae	6	1	1	8	1.1
Collybia velutipes	......	2	6	8	1.1
Coprinus micaceus	......	1	6	7	1.0
Phlebia strigoso-zonata	6	1	......	7	1.0
Fomes igniarius var. populinus	1	1	5	7	1.0
Stereum purpureum	5	......	2	7	1.0
Trechispora raduloides	2	2	2	6	.8
Polyporus hirsutus	3	......	......	3	.4
Polyporus zonatus	2	......	1	3	.4
Odontia fusco-astra	2	......	......	2	.3
Stereum murraii	1	......	1	2	.3
Odontia bicolor	1	......	1	2	.3
Flammula connisans	......	1	1	2	.3
Fomes conchatus	......	......	1	1	.1
Peniophora cinerea	......	......	1	1	.1
Trechispora brinkmanni	1	......	......	1	.1
Fomes fomentarius	......	1	......	1	.1
Sterile	31	7	32	70	9.7
Total	414	116	193	723	100.0

[1] This table includes only those trees sampled in the Boreal Forest Region.

Table 55—ASPEN[1]

Occurrence of Different Fungi and Their Association with Types of Stain

Type of Stain and Associated Species of Fungi	Frequency of Isolation: Trunk	Trunk-butt	Butt	Total	Per Cent of Identified Isolations
3. Mottled stain					
Corticium polygonium	......	......	......	35	20.9
Polyporus adustus	......	......	......	19	11.4
Stereum purpureum	......	......	......	11	6.6
Phlebia strigoso-zonata	......	......	......	9	5.4
Radulum casearium	......	......	......	8	4.8
Gleocystidium karstenii	......	......	......	7	4.2
Pleurotus subareolatus	......	......	......	4	2.4
Fomes igniarius var. populinus	......	......	......	4	2.4
Polyporus dryophilus	......	......	......	3	1.8
Pholiota adiposa	......	......	......	2	1.2
Polyporus zonatus	......	......	......	2	1.2
Pholiota spectabilis	......	......	......	1	.6
Coprinus micaceus	......	......	......	1	.6
Odontia fusco-astra	......	......	......	1	.6
Odontia bicolor	......	......	......	1	.6
Polyporus pargamenus	......	......	......	1	.6
Phlebia merismoides	......	......	......	1	.6
Steccherinum septentrionale	......	......	......	1	.6
Sterile	......	......	......	56	33.5
Total	......	......	......	167	100.0
4. Brown stain					
Corticium polygonium	......	......	......	124	35.6
Radulum casearium	......	......	......	36	10.3
Fomes igniarius var. populinus	......	......	......	21	6.0
Stereum purpureum	......	......	......	18	5.1
Polyporus adustus	......	......	......	11	3.1
Gleocystidium karstenii	......	......	......	5	1.4
Polyporus tulipiferae	......	......	......	4	1.1
Pholiota adiposa	......	......	......	3	.9
Collybia velutipes	......	......	......	3	.9
Phlebia strigoso-zonata	......	......	......	3	.9
Polyporus zonatus	......	......	......	3	.9
Polyporus dryophilus	......	......	......	2	.6
Trechispora raduloides	......	......	......	2	.6
Peniophora cinerea	......	......	......	2	.6
Armillaria mellea	......	......	......	1	.3
Pleurotus subareolatus	......	......	......	1	.3
Coprinus micaceus	......	......	......	1	.3
Polyporus hirsutus	......	......	......	1	.3
Odontia fusco-astra	......	......	......	1	.3
Stereum murraii	......	......	......	1	.3
Peniophora gigantea	......	......	......	1	.3
Sterile	......	......	......	104	29.9
Total	......	......	......	348	100.0

[1] This table includes only those trees sampled in the Boreal Forest Region.

Table 56—WHITE BIRCH

Occurrence of Different Types of Decay and Stain and Their Location

TOTAL NUMBER OF TREES........ 936
TOTAL MERCH. VOLUME (COMPUTED)........ 5,526.62 CU. FT.
TOTAL DECAY AND STAIN VOLUME (COMPUTED)........ 830.59 CU. FT.

Type of Decay or Stain	Volume (Cu. Ft.)	Per Cent of Total Decay and Stain Volume
1. White punky rot		
trunk	66.46	....
trunk-butt	65.61	.... .
butt	9.76	....
Total	141.83	17.0
2. Yellow stringy rot		
trunk	20.21	. .. .
trunk-butt	4.01	
butt	20.49	.
Total	44.71	5.4
3. Brown rot		
trunk	14.03	.... . .
Total	14.03	1.7
4. Brown stain		
trunk	165.85	..
trunk-butt	456.79	....
butt	7.38	
Total	630.02	75.9
GRAND TOTAL	830.59	100.0
Total stain	630.02	75.9
Total rot	200.57	24.1
Total	830.59	100.0
Butt rot	47.61	23.7
Trunk rot	152.96	76.3
Total	200.57	100.0

Table 57—WHITE BIRCH

Occurrence of Different Fungi and Their Association with the Types of Decay

Type of Decay and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
1. White punky rot					
Fomes igniarius	16	9	5	30	54.6
Fomes igniarius var. *laevigatus*	8	2	6	16	29.1
Peniophora cinerea	1	....	....	1	1.8
Stereum purpureum	1	....	....	1	1.8
Pholiota adiposa	1	....	....	1	1.8
Gleocystidium karstenii	1	....	....	1	1.8
Fomes conchatus	1			1	1.8
Trechispora brinkmanni	....	....	1	1	1.8
Fomes fomentarius	....	1	....	1	1.8
Sterile	2	....	....	2	3.7
Total	31	12	12	55	100.0
2. Yellow stringy					
Stereum murraii	4	1	4	9	17.0
Pholiota adiposa	1	....	7	8	15.0
Fomes igniarius	....	....	6	6	11.3
Poria obliqua	2	....	3	5	9.4
Gleocystidium karstenii	3	....	....	3	5.7
Peniophora cinerea	2	....	....	2	3.8
Fomes igniarius var. *laevigatus*	....	1	1	2	3.8
Stereum purpureum	1	....	1	2	3.8
Flammula connisans	....	....	2	2	3.8
Polyporus adustus	1	....	....	1	1.9
Polyporus betulinus	....	....	1	1	1.9
Armillaria mellea	....	....	1	1	1.9
Polyporus versicolor	1	....	....	1	1.9
Odontia bicolor	....	....	1	1	1.9
Polyporus albellus	....	....	1	1	1.9
Sterile	1	....	7	8	15.0
Total	16	2	35	53	100.0
3. Brown rot					
Stereum murraii	2	....	....	2	28.6
Pholiota adiposa	2	....	....	2	28.6
Peniophora cinerea	1	....	....	1	14.3
Gleocystidium karstenii	1	....	....	1	14.3
Pholiota spectabilis	1	....	....	1	14.3
Total	7	....	....	7	100.0

Table 58—WHITE BIRCH

Occurrence of Different Fungi and Their Association with Stain

Type of Stain and Associated Species of Fungi	Frequency of Isolation				Per Cent of Identified Isolations
	Trunk	Trunk-butt	Butt	Total	
4. Brown stain					
Stereum purpureum	1	10	2	13	14.1
Stereum murraii	2	8	1	11	11.9
Peniophora cinerea	4	7	....	11	11.9
Polyporus adustus	....	4	2	6	6.5
Gleocystidium karstenii	1	2	....	3	3.3
Pholiota adiposa	....	2	....	2	2.2
Lenzites betulina	....	2	....	2	2.2
Stereum ochraceoflavum	1	1	....	2	2.2
Fomes igniarius	....	1	....	1	1.1
Polyporus betulinus	....	1	....	1	1.1
Polyporus zonatus	1	....	....	1	1.1
Polyporus pubescens	....	1	....	1	1.1
Sterile	7	26	5	38	41.3
Total	17	65	10	92	100.0

APPENDIX C

Common and Scientific Names for Tree Species Referred to in Text

Common Name	Scientific Name*
Ash, black	*Fraxinus nigra* Marsh.
Aspen, trembling	*Populus tremuloides* Michx.
Basswood	*Tilia americana* L.
Beech	*Fagus grandifolia* Ehrh.
Birch, white	*Betula papyrifera* Marsh.
Birch, yellow	*Betula lutea* Michx. f.
Cedar, white (eastern)	*Thuja occidentalis* L.
Cherry, black	*Prunus serotina* Ehrh.
Elm, white	*Ulmus americana* L.
Fir, balsam	*Abies balsamea* (L.) Mill.
Hemlock (eastern)	*Tsuga canadensis* (L.) Carr.
Ironwood	*Ostrya virginiana* (Mill.) K. Koch
Maple, red	*Acer rubrum* L.
Maple, sugar	*Acer saccharum* Marsh.
Oak, red	*Quercus rubra* var. *borealis* (Michx. f.) Farw.
Pine, jack	*Pinus Banksiana* Lamb.
Pine, red	*Pinus resinosa* Ait.
Pine, white	*Pinus Strobus* L.
Spruce, black	*Picea mariana* (Mill.) BSP.
Spruce, white	*Picea glauca* (Moench) Voss

* Nomenclature is after Fernald (6).

Hon. J. W. Spooner
Minister

F. A. MacDougall
Deputy Minister

Report No. 26

POINT-SAMPLING, WEDGE PRISMS and THEIR APPLICATION in FOREST INVENTORIES

by R. M. DIXON

FOREST RESOURCES INVENTORY

ONTARIO DEPARTMENT OF LANDS AND FORESTS

HON. RENE BRUNELLE
Minister

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Foreword

Forest inventory and operational cruising are items that require the expenditure of money with no direct monetary return. Their value lies in the fact that they form the basis for other operations from which a financial return is obtained.

It is therefore essential that the cost of cruising bear a realistic relationship to the value of the timber involved. At the same time, however, the results which may lead to considerable expenditures must be dependable.

During the past few years an inventory method producing accurate results in a shorter time and at a lower cost has gained wide acceptance throughout Europe, the United States, and Australia.

This method—point-sampling—has been described in several publications during the past decade. This article consolidates some of this information in a readily accessible form, explains the theory of point-sampling and illustrates why it works.

In addition, a brief description is given of the stick relascope and the Spiegel-Relaskop, along with a more detailed discussion of the wedge prism. Finally, inventory methods using the relascope as the basis for volume determination through (a) tree counts and (b) tree measurements are outlined.

Contents

<u>Point Sampling</u>

Introduction

The principle of the relascope was first applied to forestry by Bitterlich in Austria in 1948, and was introduced to the United States by Grosenbaugh. The wedge prism, a simple relascope, was introduced by David Bruce of the United States Forest Service.

Relascopes have been utilized to produce a new method of cruising, variously called plotless timber estimating, plotless cruising, point-sampling, the variable plot radius method, angle count sampling, or the tree count method.

In conventional plot-sampling, the probability of tree selection is proportional to tree frequency; in point-sampling, the probability of tree selection is proportional to tree basal area. Point-sampling thus employs the idea that if an observer looks around a stand of trees with a <u>constant</u> visual angle, the number of trees which appear larger than the angle is <u>proportional</u> to the relative stand basal area.

Using a relascope to determine this constant visual angle, known as the critical angle, the cruiser rotates around a point through 360 degrees and counts the number of trees whose diameters appear larger than the critical angle. By multiplying the number of trees by a constant—the basal area factor—the basal area per acre is immediately obtained.

Theory

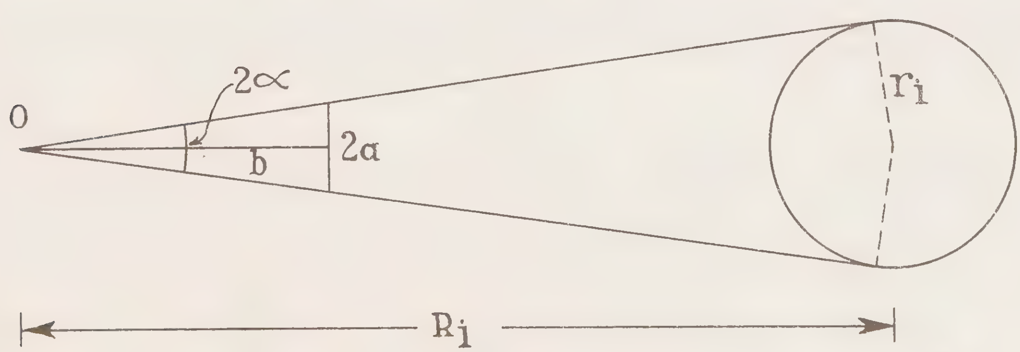
The theory of point-sampling can be explained as follows:

(1) Let there be n_i trees per acre, of radius r_i measured in feet. Then the basal area per acre of the stand will be

$$n_1 \pi r_1^2 + n_2 \pi r_2^2 + - - - - - - + n_n \pi r_n^2 \ .$$

(2) In the following figure, let <u>O</u> be the observer's position at a randomly selected sampling point. Let <u>2a</u> be the length of the cross-piece of the relascope and <u>b</u> the length of <u>the</u> rod. Then 2α, the reference angle of the instrument, is expressed by

$$\tan\alpha = \frac{a}{b} \ .$$



(3) Also, if R_1 is the maximum distance within which trees of radius r_1 are counted,

$$\sin \alpha = \frac{r_1}{R_1}$$

(4) If x_1 trees of radius r_1 are counted from one sampling point, the estimated number per acre of trees of this radius will be

$$x_1 \times \frac{43560}{\pi R_1^2}$$

since there are 43,560 square feet in one acre, and the estimated basal area of trees of this radius will be

$$43560 \times x_1 \frac{\pi r_1^2}{\pi R_1^2} = 43560 \, x_1 \sin^2 \alpha .$$

(5) While the maximum distance within which trees of various diameters will be counted will vary, the ratio of the radius to this distance is constant.

(6) Thus, substituting $k = 43560 \sin^2 \alpha$, we have the total basal area per acre estimated from one point equal to

$$k \, (x_1 + x_2 + \; - - - \; + x_n) = k \, X$$

where X is the total number of trees counted in one sweep (i.e., one rotation of observer through 360 degrees around sampling point).

(7) The constant k, determined by the reference angle 2α, is the basal area factor of the instrument.

Illustration of Why the Theory Works

This theory may be more clearly understood by considering a common relascope in which the rod, b, is 33 inches long and the cross-piece, 2a, is one inch. This produces a critical angle, 2α, of 104.18 minutes and a basal area factor, k, of 10.0. In addition, the maximum distance within which a tree of given diameter is counted, R, may be expressed as D.B.H. x 33. This distance, commonly called a plot radius factor, is generally shown as 2.75 (i.e., $\frac{33}{12}$) when d.b.h. is expressed in inches and plot radius in feet.

The following table illustrates how, with this relascope, the basal area factor remains at 10.0 regardless of the tree diameter:

D.B.H. Inches	(1) Plot Radius feet	Plot Size acres	(2) Per Acre Conversion Factor	Basal Area of One Tree sq. ft.	(3) Basal Area per Acre sq. ft.
6	16.5	0.019625	50.96	0.196	10.0
12	33.0	0.078500	12.74	0.785	10.0
18	49.5	0.176625	5.66	1.767	10.0
24	66.0	0.314000	3.18	3.142	10.0
30	82.5	0.490625	2.04	4.91	10.0

(1) D.B.H. x 2.75.
(2) Number of trees per acre for each tree counted on the cruising plot.
(3) Equal to the product of "per acre conversion factor" x "basal area of one tree."

If, with a critical angle of 104.18 minutes, one 6-inch d.b.h. tree is counted, we know this tree is located on a plot whose radius is 16.5 feet (2.75 x d.b.h. inches = plot radius in feet). This plot size represents 0.019625 acres ($\frac{\pi r^2}{43,560}$), containing a basal area of 0.196 square feet.

An area of one acre would contain 50.96 such 6-inch d.b.h. trees, each having a basal area 0.196 square feet. Thus basal area per acre becomes 50.96 x 0.196 = 10 square feet.

Similarly, it can be demonstrated that this relationship holds true regardless of the tree diameter. A thirty-inch d.b.h. tree, for example, occurs within a plot having a radius of 82.5 feet and an area of 0.490625. In this case, one acre contains 2.04 trees of this diameter, each having a basal area of 4.91 square feet, and basal area per acre is 2.04 trees x 4.91 square feet, which equals 10 square feet.

The above table and explanation demonstrate why, with this relascope, a constant factor of 10.0, when multiplied by the number of trees counted, produces basal area per acre. This remains true regardless of the diameters of the trees counted, because each tree, irrespective of its size, represents a certain number of trees per acre, whose combined basal area is equal to 10 square feet.

This fact of assessing 10 square feet per tree counted, regardless of tree d.b.h., causes confusion since it appears to give the same weight to small and large trees. It is essential, therefore, to recognize that not only tree size but also tree position is taken into consideration. The point-sampling technique involves the establishment of a series of concentric circular plots about the sampling point. Each circle outlines the area from which trees of a specific diameter will be counted. The circle increases in relation to the tree diameter, larger trees being counted at a greater distance from the sampling point than smaller trees. There is thus a greater area sampled for larger trees. This variation in the sampled area is compensated for by the basal area factor, which automatically adjusts the tree count to basal area per acre.

Critical Angles

An almost infinite number of critical angles could be used, having basal area factors ranging from 0 to 200 or more. A relascope with a factor of 10 is common, but 40 and 50 factors are also used, with critical angles of 208.38 and 232.99 minutes, respectively.

Larger angles are used in dense stands or in stands with a dense understory or shrub growth which restrict vision. As the angle is increased, fewer trees are counted, and these occur closer to the sampling point where they are more readily visible. Conversely, smaller angles would increase the plot radii and the number of trees counted. They would thus be more suitable for open stands of larger trees. It is thus apparent that the critical angle used, as well as the tree diameter, affects the plot size.

The following table will indicate a range of convenient critical angle gauges:

Critical Angle (Minutes)	Basal Area[1] Factor	Plot Radius[2] Factor
32.94	1	8.696
73.66	5	3.889
104.18	10	2.750
147.34	20	1.944
208.38	40	1.375
232.99	50	1.230
285.37	75	1.004
329.55	100	0.8696
403.70	150	0.7100
466.24	200	0.6149

[1]Multiply by number of trees at sampling point to obtain basal area per acre in sq. ft.

[2]Multiply by tree d.b.h. in inches to obtain plot radius in feet.

Application

Point-sampling may be applied in any forest stand regardless of age, composition, or stocking, provided that the stems to be counted are clearly visible to the observer. It is a method of sampling that does not require the establishment of the plot area, nor the direct measurement of tree stems.

The observer, from a number of points selected in an unbiased manner, sights an angle gauge at each tree in turn as he completes a circle about the point. During this operation, he counts all trees with diameters at breast height which appear wider than the width of the gauge. Basal area per acre is obtained for each point by multiplying the total tree count per sweep by a known constant, the basal area factor.

Advantages

1. It eliminates the largest source of error in conventional line plot and strip cruises—the inaccurate estimation of plot radii and strip width.

2. It permits an increase in the number of stands sampled, while reducing the time and labour required, and thus allowing a better distribution of samples throughout the area.

3. It avoids the measurement of an excessive number of small trees.

4. It reduces the time and cost of timber volume estimation.

Disadvantages

1. It provides only gross basal area per acre and nothing else.

2. Errors can be produced by missing trees hidden from the observer by intervening trees or brush.

3. Inaccuracies in the tree count can be caused by the incorrect estimation of breast height.

4. It is necessary to correct for slopes exceeding 10 degrees.

Accuracy

Experiments in the United Kingdom, Australia, Japan, and the United States indicate that this method produces results comparable to plot-sampling.

As an example of the results obtained, Grosenbaugh and Stover (1957) indicate that on a 4 million acre tract in Texas, point-samples varied from ¼-acre plots as follows:

(a) 0.1 per cent lower basal area than the plot-sample.

(b) 0.1 per cent higher cubic foot volume per acre than the plot-sample.

(c) 1.1 per cent lower board foot volume per acre than the plot-sample.

Instruments

While a number of instruments have been developed for point-sampling, only three are described here to illustrate the variety available.

Stick relascope— A simple instrument, consisting of a rod 33 inches long, having a peep-hole at one end and, at the opposite end, a metal strip, with a one-inch slot, attached at right angles to the rod. This produces a basal area factor of 10.0.

Spiegel-Relaskop— A precision instrument, this mirror relascope has a choice of four basal area factors, 5, 10, 20, and 40. It automatically corrects for slopes by varying the widths of the scales along their lengths. In addition to estimating basal area, this instrument can be used as:

(a) a hypsometer, to measure tree heights, in feet.

(b) a dendrometer, to determine tree diameter at any height.

(c) a range finder, to determine horizontal distance in feet.

(d) a clinometer, to measure slopes in degrees or percentages.

Wedge prism— A thin wedge of glass that bends light rays, thus producing a split image when the tree is viewed both through and over the prism by the observer.

Wedge Prism

General

The wedge prism is one of the simplest and most convenient means of establishing a critical angle. In this case, the cruiser counts all trees that are not cut in two (i.e., not completely offset) when viewed through the prism.

Prism strengths are measured in diopters, and the relationship between diopters and basal area is illustrated below:

Diopters (prism strength)	2.0	3.0	4.0	5.0	6.0	7.0
Basal area factor	4.4	9.8	17.4	27.2	39.2	53.3

In general, prisms may be divided into two classes:

1. High-accuracy factory-calibrated prisms, with a specific basal area factor accurate to 1 or 2 per cent. These may be purchased for prices between ten and fifteen dollars per prism.

2. Non-calibrated prisms that are not manufactured to a close tolerance and may vary by as much as 0.1 diopter high or low. These can be purchased for between $1.50 and $2.00. They must be calibrated by the purchaser prior to field use.

Calibration

This consists of determining the amount of image deflection in relation to the distance between the prism and the target. Two simple methods are outlined below:

(a) Measure the distance required to produce a given deflection.

(1) Set up a rectangular target of some convenient width (1, 2, or 3 feet).

(2) Lay a steel measuring tape along the centre line, perpendicular to the target.

(3) Move along this line until one side of the target image seen through the prism is precisely aligned with the other side seen over the prism.

(4) Measure accurately the distance from prism to target.

(5) Basal area factor for estimating square feet per acre is:

$$\frac{43,560}{1 + 4\left(\frac{d}{w}\right)^2}$$

where: w = target width in feet

d = distance from prism to target in feet.

(b) Measure the amount of deflection at a fixed distance.

(1) Fix prism in position at one end of a long table.

(2) At the other end, at right angles to face of the prism, set up a target of two vertical pins that can be moved in relation to each other.

(3) Measure accurately (d) the distance between target and prism.

(4) Move pins until the displaced image of one pin coincides exactly with the image of the other. Measure the distance between the pins (w) precisely.

(5) Basal area factor calculated using formula in (5) above. It is essential that d and w be measured in the same units.

Consideration of Cost

While precisely calibrated prisms cost more than uncalibrated ones, this increased cost may be more than compensated for by a reduction in the time and cost of compilations and an increase in their accuracy. The use of a standard basal area factor will reduce, or entirely eliminate, errors caused by incorrect prism calibration, by the use of a factor of the wrong prism for a specific sample, and by mathematical mistakes.

It is obviously easier to have all data collected in the field multiplied by a factor of 10, for example, rather than to have some data multiplied by 9.6, and some by 10.3. In the latter case, the possibility of error is greatly increased both by the application of the *wrong factor* to a given set of data and by mathematical errors even when the *correct factor* is applied.

Advantages of Prism

1. Since the tree image remains still even when the prism moves, an unsteady hand presents no difficulty.

2. The eye is focused on the tree alone, while with a relascope it is difficult to focus clearly on near and far points simultaneously.

3. It is necessary to check the alignment of only two lines, while with a relascope it is difficult to align two reference points with two sides of the tree while the instrument is wobbling.

Disadvantages

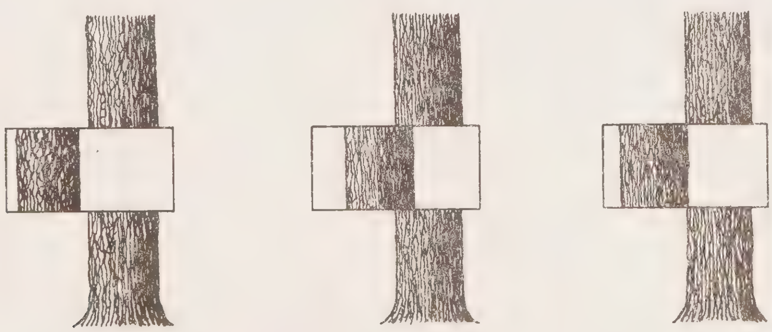
1. Unless an achromatic (colour-corrected) prism is used, the "rainbow" around the edges of the image impedes the critical inspection of its relative displacement.

2. Unless the prism is precisely ground to previously determined specifications, the cruiser may have to use fractional basal area factors.

3. It is necessary to make slope corrections, which are automatically taken care of by the Spiegel-Relaskop.

Method of Use

1. The cruiser counts all the trees around a sampling point that are *not* cut in two when viewed through a wedge prism.



Do not count. Count. Borderline.

2. Borderline trees may be dealt with by: (a) counting every other borderline tree or (b) measuring out to the tree, measuring its d.b.h. and calculating distance at which such a tree should be included (e.g., with factor of 10.0, calculation is 2.75 x d.b.h. inches = plot radius in feet).

3. Multiply number of trees tallied by basal area factor of prism to obtain basal area around the sampling point.

4. It is essential that the prism be held over a fixed sampling point as the observer turns to check the trees around the point. Distance of the eye from the prism may vary.

5. Face of the prism should be at right angles to the line of sight. Deviations of 5 degrees will cause no measurable error.

6. Slope errors will be serious for slopes of more than ten per cent. They may be eliminated by a per cent correction for each per cent of slope, or by rotating the prism through exactly the same angle as the slope, in a plane at right angles to the line of sight.

7. It is permissible to move from the established point to see better a tree hidden by brush or other trees provided the same distance to the tree is maintained.

8. As in all sampling, care must be taken to avoid bias in locating the sampling point.

9. An accurate tree count must be made, preferably by two sweeps. Care must be taken to omit dead trees and, if yield tables are used, to omit those trees not in the main canopy.

Field Application

A. Tree Count

It is readily apparent that the greatest saving in time and money will be obtained through the field application of angle gauges to merely count trees around a sampling point. Since this produces only gross total basal area, it is necessary to have, in addition, a rapid and reliable method of converting basal area to the volume desired, cubic feet, cords or board feet.

Methods utilizing a tree count should be of great value in forest inventories where the main concern is an estimation of the volume on an area, rather than volume by diameter classes. Several procedures have been described for converting from basal area to volume: some are indicated below:

(1) $$V = s \times h \times f$$

where:

V = volume per acre at sampling point.
s = basal area per acre (determined by the angle count).
h = mean height of the stand.
f = mean form factor of the stand.

(2) Calculate, for each height class recognized, a height factor by determining for each d.b.h. class the ratio $\frac{\text{d.b.h. volume}}{\text{d.b.h. basal area}}$; average these individual factors to obtain one factor per height class. Volume for the stand then

becomes: Volume = basal area x factor.

(3) Prepare, for representative stands, a stand volume table showing total volume per acre by known total basal area per acre and mean height class.

(4) A method investigated by Forest Resources Inventory during 1958 was the utilization of Normal Yield Tables to convert basal area, obtained by angle gauges, to gross total volume per acre. The procedures used are described in detail below, since the method proved very satisfactory.

1. For a stand, ten point-samples were taken at two-chain intervals along a predetermined compass course.

2. Tree counts were recorded by species and averaged for the ten points.

3. The averaged total tree count x basal area factor = basal area per acre.

4. Species composition was determined from the tree count and shown to nearest 10 per cent for each species (e.g., Pj_6 Sb_3 Po_1).

5. Total stand age was determined from a ring count at stump height of a tree of average d.b.h. of the major species, plus an estimate of the number of years required to reach stump height.

6. Stand height was obtained to the nearest foot by measuring a tree of average d.b.h. of the major species belonging to the main storey.

7. Site class was obtained by reading average stand height over average stand age from the appropriate figure in the Normal Yield Tables (Report No. 24)[1] and recorded to nearest full number 1, 2, or 3.

8. Stocking was determined by dividing actual basal area per acre by normal basal area per acre as shown in appropriate table in the Normal Yield Table.

9. Volume per acre was determined by multiplying the normal volume from the appropriate Normal Yield Table by the stocking factor.

The number of point-samples per stand was arbitrarily chosen prior to the field work. It is now evident that a more efficient procedure would be to vary the number taken in an individual stand dependent upon its age, composition, and stocking. For example: younger age classes in which errors will not be as important could have fewer samples; mixed stands require more samples than pure stands; and poorly stocked stands require more than fully stocked stands due to the erratic distribution of the stems in the former.

To determine the reliability of this method, one-acre sample plots were calipered in mature stands, and ten point-samples were taken at intervals along the centre line of the plot. While, to date, little of this information has been compiled, early indications are that the results using the prism and yield table did not vary greatly from those obtained using a tallied one-acre sample plot and standard volume tables.

Comparison of Point-Samples and Plot-Samples

The following table of plots in the Cobalt Management Unit, North Bay Dis-

[1] Plonski, W. L.—Normal Yield Tables for Black Spruce, Jack Pine, Aspen, and White Birch in Northern Ontario—Ontario Department of Lands and Forests, 1956.

Stand Number	Plot Size Acres	Species Composition (from Basal Area to Closest 10 Per Cent) Prism-Sample	Plot-Sample	Basal Area (sq. ft.) Prism-Sample	Plot Sample	% Variation from Plot-Sample
271	0.5	Po5 Sw2 Bw1 B1 Pj_1	Po6 Sw2 $(AbBwSbB)_2$	109	106.80	+ 2.0
C.252	1.0	Po5 PR2 Sw1 B1$(PwCeBw)_1$	Po4 PR3 Sw_1 Pw_1 $(BBwCe)_1$	86.5	114.86	-24.7
251	1.0	Po5 PR3 Sw1 $(PwB)_1$	Po5 PR3 Sw_1 $(PwB)_1$	118.1	133.91	-11.8
250	0.5	Po3 Bw3 Sw2 B_1 $(PRPw)_1$	Po_3 Bw_2 Sw_2 B_1 PR_1 $(PwCeBy)_1$	113.5	114.90	- 1.2
249	0.5	Mh_5 By_2 Bw_1 Ce_1 B_1	Mh_4 By_2 Ce_1 Bw_1 $(SwPw)_1(AbPoB)_1$	75.3	79.20	- 4.9
248	1.0	Mh_4 Bw_3 By_2 Ce_1	Mh_5 Bw_2 By_1 Ce_1 $(BAbSw)_1$	96.7	96.12	+ 0.6
242	1.0	Pw_3 Bw_3 PR_2 B_1 MR_1	Pw_3 Bw_3 PR_2 Sw_1 $(BCeMRPo)_1$	57.0	53.50	+ 6.5
A.238	0.5	Po_5 Bw_2 PR_2 Pw_1	Po_4 PR_3 Bw_2 Pw_1	96.0	69.30	+38.5
233	1.0	B_3 Bw_3 Ce_2 Pw_1 Po_1	Bw_4 Ce_2 Sb_1 B_1 $(PwPR)_1$ (PoSwMR, etc.)$_1$	88.4	91.50	- 3.3
229	0.5	B_3 PR_2 Po_2 Sw_2 Bw_1	Po_3 PR_2 Sw_2 Bw_1 B_1 $(PwCe)_1$	90.0	88.22	+ 2.0
225	0.5	Ce_3 Bw_2 B_1 MR_1 Pw_1 Sw_1	Ce_4 Bw_4 Sb_1 MR_1	73.0	73.71	- 1.0
134	1.0	Sb_5 Po_2 Pj_2 Bw_1	Sb_4 Pj_3 Bw_1 Po_1 Sw_1	54.0	60.56	-10.8
130	1.0	Bw_3 Sb_3 Po_2 Pw_2	Po_3 Bw_2 Pw_2 Sb_2 PR_1	96.0	95.98	—
129	1.0	PR_3 Pw_3 Po_2 $Bw_1(MRSbPj)_1$	PR_5 Pw_2 Po_1 Bw_1 $(SwBPj)_1$	66.0	60.74	+ 8.7
127	1.0	Pw_4 Sb_3 Bw_2 PR_1	Bw_3 Pw_3 Sb_1 PR_1 Po_1 $(SwPj)_1$	86.0	88.19	- 2.5
126	1.0	PR6 Pw_3 $(BwSw)_1$	PR_6 Pw_3 $(PoBwSwPjMR)_1$	128.0	132.81	- 3.6
125	1.0	Bw_2 Po_2 $B_1Pw_1Sb_1Pj_1Ab_1Ce_1$	Bw_2 Po_2 Pw_2 B_1 Sb_1 Pj_1 PR_1	86.0	83.8	+ 2.6
124	1.0	Pw_3 Po_3 Sw_3 Bw_1	Pw_3 Po_3 Sw_3 Bw_1	87.0	86.05	+ 1.2
123	1.0	Bw_3 Pw_3 Po_3 Sb_1	Bw_3 Pw_3 Po_2 Sb_2	100.0	88.69	+12.8
B.121	0.5	B_4 Bw_2 Sw_2 $(PoPw)_1$	Sw_4 Bw_2 Po_2 Pw_1 B_1	46.0	57.83	-20.5
C.390	0.5	Sw_3 Bw_3 Ms_2 Po_2	Sw_3 Po_2 Bw_2 Pw_1 $(PRPj)_1$ Ms_1	81.0	112.42	-27.9
385	1.0	Bw_2B_2 $Ce_2Sb_1(PwPR)_1Ms_1Po_1$	Bw_3 Po_2 Ce_2 Sb_1 $(PwPR)_1$ $(MsBAb)_1$	73.0	79.60	- 8.3
384	1.0	Po_3 Bw_2 $(PwPR)_2$ Ms_2 Sw_1	Po_4 Pw_2 Bw_1 Sw_1 PR_1 B_1	90.0	109.60	-17.9

A. Plot located on rocky side-hill, thus possible error in both plot-sample and prism-sample.
B. Heavy underbrush, thus probable that trees were missed in prism-sample (with a 10 factor prism, 1 tree would account for 10 sq. ft. basal area).
C. No apparent reason for discrepancy between the two methods.

trict, shows the variation in basal area and species composition between point-samples and plot-samples for a number of stands. It should be noted that the comparisons shown are for an area in which a great variety of species occur together in mixed stands. This represents an extreme condition regarding species composition. It is, however, interesting to note how closely the species composition and basal area, arrived at by the two methods, compare. These comparisons are between point-samples and plot-samples taken as part of a normal cruise; thus errors may occur in either method. For purposes of comparison the plot basal area was accepted as correct, although errors may occur here as readily as on the point-samples.

B. Tree Measurement

Many agencies use the relascope merely to determine the trees to be tallied, and record trees by diameter classes and species. Since no plot size is obtained in point-sampling, it is again necessary to evolve procedures for determining volume per acre.

Such methods could well be adapted to operational cruises where it is necessary to produce stand and stock tables. It should be noted, however, that when it becomes necessary to caliper trees, much of the advantage of this system (the speed of the tree count) is lost. Nevertheless, it appears, from published literature, that it is still more rapid than conventional methods, probably because of the fewer trees included at each point. In addition, it eliminates the tally of numerous small-diameter trees and increases the proportion of the larger-diameter trees tallied (since larger d.b.h. trees are included on a larger plot area).

Points should be located in an unbiased manner, and the number required will depend upon both the accuracy required and the character and size of the stands being sampled.

Various methods have been outlined for point-samples where tree diameters are calipered. It will be sufficient here to indicate methods involving the construction of stand and stock tables.

Stand and Stock Table

To construct a stand table, the number of trees in each size class must be converted to number of trees per acre, as follows:

(1) Total basal area per acre $= \dfrac{\text{number of trees tallied x basal area factor}}{\text{number of points sampled}}$

(2) Number of trees per acre $= \dfrac{\text{total basal area per acre}}{\text{basal area of the tree at the mid-diameter of the class}}$

For example:

Twenty-six 6-inch trees were counted on 10 sampling points with a prism having a basal area factor of 10.0.

(1) Basal area per acre of 6-inch trees $= \dfrac{26 \times 10.0}{10} = 26.0$ Sq. ft. per acre.

(2) Number of 6-inch trees per acre $= \dfrac{26.0}{0.196} = 132.7.$

A stock table may now be readily constructed by multiplying the numbers of trees per acre for each diameter class by the volume per tree obtained from a

local volume table, to produce volume per acre.

$\therefore$ Volume per acre = 132.7 x 3.25 = 431.3 cu. ft.

Stock Table

A second method of obtaining a stock table, without preparing a stand table, is:

(1) Volume ratio for each d.b.h. class = $\dfrac{\text{vol. per tree from local volume table}}{\text{basal area per tree}}$

(2) Volume per acre = volume ratio x basal area per acre.

For example:

Twenty-six 6-inch trees were counted on 10 sampling points with a prism having a basal area factor of 10.0.

(1) Volume ratio = $\dfrac{3.25}{0.196}$ = 16.58.

(2) Volume per acre = 16.58 x 26.0 = 431.1 cu. ft.

The two methods outlined above show a discrepancy of 0.2 cu. ft. In theory, the first method is not entirely accurate since the average basal area of an inch-class will not necessarily be equal to the basal area of the tree of mid-diameter. In actual practice, however, the resulting error will seldom be of practical importance.

2, 4, 6 8, 10, 12

$\frac{\pi D^2}{4} = B.A.$

$1/33 = \frac{d}{R}$

$\frac{\pi D^2}{4} \times \frac{43,560}{12\pi R^2}$

$R = \frac{33d}{12}$

$R = 2.75d$

$= \frac{D^2}{R^2} \times 907.5$

$R = 33D$

$R = 33/12\,D$

$1/33 = d/R$

$\frac{1}{R} = 2.75D$

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BA_i = Tree No × BA Factor

Take Height & Diam, Bark, & Diam of each tree.

BA / plot

5, 6, 7

$$\frac{\pi D^2}{4 \times 144}$$